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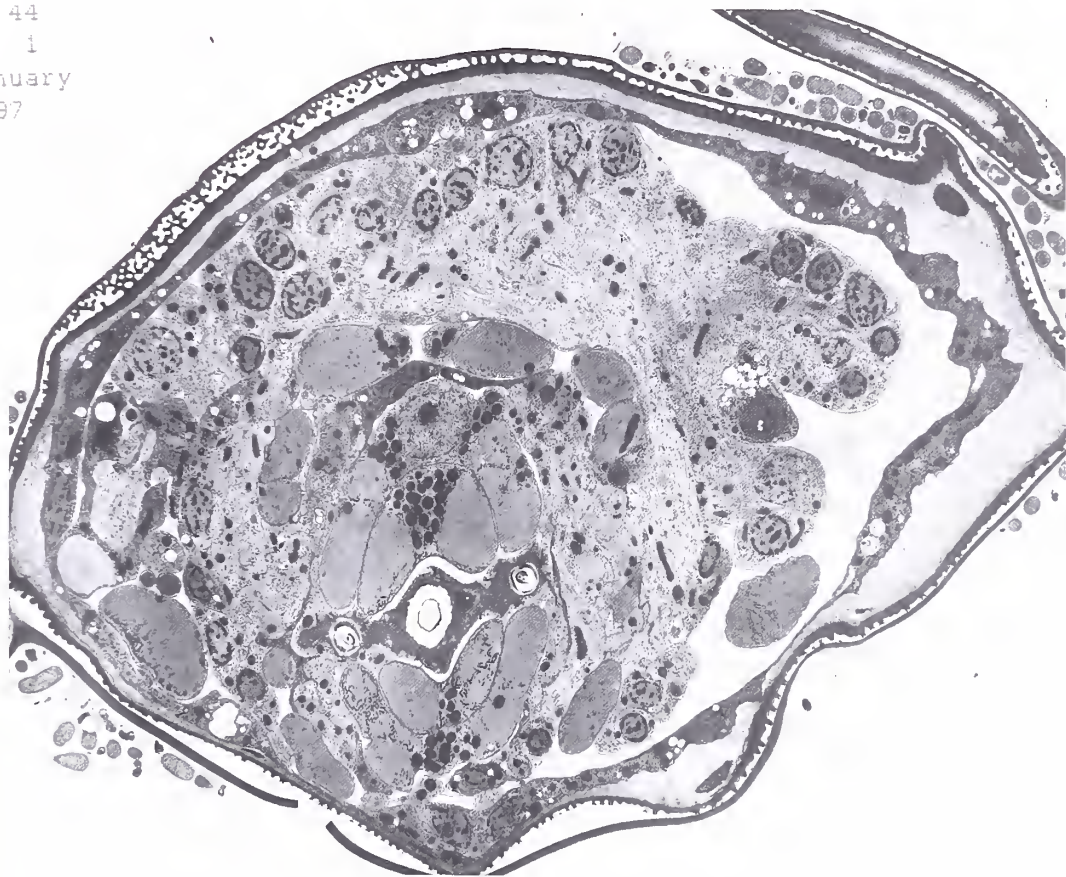
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The ASB BULLETIN

Volume 44, Number 1

January 1997

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Cross-section from a series through the brain of the tardigrade *Echiniscus viridissimus* Peterfi. $\times 3050$.

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The purpose of this Association shall be to promote the advancement of Biology as a science by encouraging research, the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. Members receive the Bulletin.

TIME AND PLACE OF FUTURE MEETINGS

1997	April 16-19	Furman University, Greenville, SC
1998	April	Northeast Louisiana University, Monroe, LA
1999	April	University of North Carolina at Wilmington, Wilmington, NC

PATRON MEMBERS

Associated Microscopes, Inc. Burlington, NC
Breedlove, Dennis and Associates, Inc. Orlando, FL
W. C. Brown Publ. Co., Dubuque, IA
Carolina Biological Supply Co., Burlington, NC
Lockheed Martin Energy Research Corporation, Oak Ridge, TN
Martin Microscope Co., Easley, SC
Saunders College Publishing Co., Philadelphia, PA

A MESSAGE FROM THE PRESIDENT

1997 ENRICHMENT FUND CHALLENGE

An Enrichment Fund Challenge is being offered again for 1996-97. For those of you who are unfamiliar with the Challenge, the past several years I have offered to match contributions from ASB members up to a specified amount. This year the amount is \$3,000.

As most of you know, Steve Dial played an important role in setting up the Enrichment Fund which is becoming increasingly important to the organization. Unfortunately, this summer his son was killed in a boating accident. Such unexpected losses are tragic and devastating, and on behalf of ASB, I offer Steve and his family our deepest sympathy. Therefore, the matching contribution is being offered in memory of Steve Dial Jr. Member contributions may be made by check, payable to the ASB Enrichment Fund, and sent to Gerhard Kalmas, Department of Biology, East Carolina University, Greenville, SC 28785, or contributions may be made at the annual meeting in April.

One of the goals of ASB and the Meritorious Teaching Award is to recognize excellence in teaching. Unfortunately, this goal is not being realized to the extent the Executive Board would like. I want to take this opportunity to encourage those of you who have a colleague or mentor, which you feel is an excellent teacher that deserves recognition, to contact Diane Nelson, Chair of the Meritorious Teaching Award Committee. Nomination forms and a list of past recipients of the award are on the next page. Documentation, primarily letters, is required but it is worth the effort. As a recipient of the Faculty Research Award a few years ago, I can attest to the fact that these awards become an important benchmark in personal life. Please make the effort to recognize an outstanding teacher.

Jim Fralish
ASB President

Members are urged to nominate outstanding teachers for this award, using the following form, and include supporting documentation (biographical sketch or *c.v.* supporting letters, photograph of candidate, *etc.*) One nominator should collect all nominations and send them, along with other required information and the following form to:

Dr. Diane Nelson, Chair
Meritorious Awards Committee
Department of Biology, East Tennessee State University
Johnson City, TN 37614-0703

NOMINATION -- ASB MERITORIOUS TEACHING AWARD, 1997

NAME:

ADDRESS:

TEACHING INTERESTS:

NOMINATOR NAME/ADDRESS:

Supporting documentation:
(enclosed, in triplicate)

letter of nomination

supporting letters

curriculum vitae

additional information (list)

ASB Meritorious Teaching Award Winners

1952	Mary MacDougall	1974	Grace J. Thomas
1953	Orland E. White	1975	L. M. Outten
1954	Woolford Baker	1976	Jonathan J. Westfall
1955	John N. Couch	1977	Margaret L. Gilbert
1956	Hugo Blomquist	1978	Albert E. Radford
1957	Ezda M. Deviney	1979	Eugene P. Odum
1958	Henry R. Totten	1980	Robert B. Short
1959	Margaret N. Hess	1981	William D. Burbank
1960	Ora C. Bradbury	1982	Fred H. Norris
1961	Warren Deacon	1983	Frederick T. Wolf
1962	Septima C. Smith	1984	Robert H. Mohlenbrock
1963	Patrick Yancey	1985	Margaret Y. Menzel
1964	Ruskin S. Freer	1986	Lafayette Frederick
1965	H. P. Sturdivant	1987	Stewart Ware
1966	Charles Ray, Jr.	1988	Elsie Quarterman
1967	H. J. Oosting	1989	John M. Herr, Jr.
1968	Wade T. Batson	1990	J. Charles O'Kelley
1969	William L. Mengebier	1991	James Hardin
1970	Elton C. Cocke	1992	no award
1971	Earl L. Core	1993	Eloise Carter
1972	Aaron J. Sharp	1994	T. Larry Mellichamp
1973	H. H. Hobbs, Jr.	1995	J. Whitfield Gibbons
		1996	no award

58TH ANNUAL MEETING IN GREENVILLE, SOUTH CAROLINA

Furman University and the Department of Biology welcome the Association of Southeastern Biologists to Greenville, South Carolina for the 58th annual meeting, April 16-19, 1997. All activities except the Thursday evening social and field trips will be held at the Hyatt Regency Greenville.

SOCIETIES MEETING WITH ASB IN GREENVILLE

American Society of Ichthyologists and
Herpetologists, Southeastern Division (ASIH)
Beta Beta Beta (BBB)

Botanical Society of America, Southeastern Section (BSA)
Ecological Society of America, Southeastern Chapter (ESA)
Society of Wetland Scientists, South Atlantic Chapter (SWS)
Southeastern Fishes Council (SFC)

Southeastern Society of Parasitologists (SSP)
Southern Appalachian Botanical Society (SABS)

FURMAN UNIVERSITY AND GREENVILLE

Greenville, South Carolina is a metropolitan city of about 350,000 people. Its location, only a few miles from the Blue Ridge escarpment, influenced its early history as a summer retreat for low-country planters. Abundant water power led Greenville to assume a position of world leadership in the textile industry; however, more recently the economy has diversified greatly, ranging from service industries to BMW automobiles. The downtown area, where the meetings will be held, has staged a renaissance within the last decade, and abounds with places to eat, shop, and socialize. The weather in April should be mild, with highs in the 70's and lows in the 50's. An abundance of natural habitats are close by for enjoyment of the spring flora and fauna. These range from urban parks in walking distance from the meeting site; to Paris Mountain State Park, on a monadnock rising about 1000 feet above the city to the state parks, heritage preserves, and other protected lands that compose the 11,000-acre Mountain Bridge wilderness area in the South Carolina Blue Ridge province.

Furman University is an independent, coeducational, liberal arts college located on a 750-acre suburban campus on the outskirts of Greenville, South Carolina. Founded by South Carolina Baptists in 1826, the university is an old institution; yet its facilities are modern, all the buildings on the present campus having been constructed since the late 1950's. Most of Furman's 2,500 undergraduates are from the South Atlantic region, but more than 40 states and 15 foreign countries are represented in the student population. Working with the Furman students are a faculty and staff whose primary concern is to enhance student learning. Over 90 percent of the faculty hold doctoral degrees in their academic disciplines. Twenty-two academic departments at Furman offer 36 majors. Visit Furman at www.furman.edu on the web.

The Department of Biology at Furman University maintains a quality undergraduate program that is cognizant of the rapidly changing and expanding field of biology and prepares students for careers or further education in one or more of the diverse areas of biology. The Biology Department with twelve faculty members, two support staff and about 300 majors offers a variety of classroom and field courses including a winter term study/travel course to Central and South America. The department's home page at www.furman.edu/~snyder/ gives more complete information.

TRAVEL TO AND WITHIN GREENVILLE

Automobile:

Greenville is located in the northwest corner of South Carolina. The city is easily accessed by I-85 from the southwest or northeast, by I-26 (to US 25) from the north, and either by I-26 (to I-385) or by US 25 from the south.

Air Travel:

Greenville-Spartanburg Airport is located about 15 miles from downtown Greenville. AAA Travel Agency (800-759-2621) can handle your airline reservations and ticketing at discounted prices. Please advise them that you will be attending the Association of Southeastern Biologists meeting in Greenville, SC. AAA has arranged a 5% discount off the lowest advance purchase fare (requires a Saturday night stay) or 10% off the regular coach fare on both Delta and US Air. They have also arranged special zone fare pricing for ASB participants with Delta.

The Hyatt Regency Greenville will provide free shuttle service between the hotel and the Greenville-Spartanburg Airport for guests staying at the hotel. Arriving passengers should contact the Hyatt directly through courtesy phones at the airport. Those with alternative accommodations can make reservations for rental cars at the Greenville-Spartanburg Airport or can contact AAA Travel Agency to arrange shuttle service to the Hyatt. From the airport, take I-85 south to I-385 north to Greenville.

ACCOMMODATIONS

Conference participants are encouraged to stay at the Hyatt Regency Greenville, 220 North Main Street. A block of rooms is available at a special rate of \$75.00 per room per night (four person maximum per room). Conference participants should make reservations directly with the Hyatt prior to March 19, 1997 (800-233-1234; 864-235-1234). Be sure to mention the "ASB" when making your reservation. After March 19, reservations will be taken on a space-available basis. A parking pass for Hyatt guests will be available upon payment of a nominal fee at the main check-in desk of the Hyatt. A limited number of parking passes will be available on a first come, first served basis for individuals not staying at the Hyatt. If you would like to investigate alternative accommodations, contact the AAA Travel Agency (800-759-2621).

PRE-REGISTRATION AND REGISTRATION

A pre-registration form is provided with this copy of the *Bulletin*.
The **deadline** for receiving pre-registration materials is **March 31, 1997**.

Pre-registration is necessary to ensure the most effective planning for field trips, meals, and social events. Pre-registration packets will be available at the conference registration desk in the lobby of the Hyatt Regency Greenville on Wednesday, April 16, 1997 from noon-10:00 p.m. and Thursday, April 17, 1997 from 8:00 a.m.-5:00 p.m. Late registration will be held at the same times/location. Pre-registration fees are refundable, less an administrative fee, if cancellation notification is received by 5:00 p.m., March 31, 1997 (contact Dr. Lew Stratton: lew.stratton@furman.edu; 864-294-3249). There will be a \$5.00 administrative fee for student cancellations and a \$10.00 administrative fee for non-student cancellations. *Fees are non-refundable after March 31, 1997.*

PROGRAM INFORMATION

Please take your April 1997 *ASB Bulletin* containing the detailed program and abstracts to the meeting. Copies will be sold at the meeting registration desk for \$4.00. Detailed program information including the schedule of talks will also be available on the World Wide Web (www.furman.edu/~pollard/ASB/). Check the Web site frequently for the latest meeting updates.

Wednesday Evening ASB Social

A social with cash bar will be held in the Atrium of the Hyatt Regency Greenville from 7:30-10:00 p.m.

Thursday Evening BBQ Buffet

The Thursday evening gathering will be held from 6:30-10:30 p.m. at the Peace Center for the Performing Arts and will feature an "all you care to eat" barbecue/fish-fry buffet, beer and other refreshments, and live music. The Peace Center occupies a complex of restored historic textile mills, on the banks of the Reedy River, near the original site of downtown Greenville. The walk from the Hyatt is a pleasant stroll of less than 1/2 mile. Those who expect to need assistance with transportation should check the box on the pre-registration form.

Friday Evening ASB Banquet

The ASB Banquet will be held from 7:30-10:00 p.m. at the Hyatt Regency Greenville and will feature a choice of entrees (fish, poultry, vegetarian).

TENTATIVE GENERAL SCHEDULE

All events will take place at the Hyatt Regency Greenville with the exception of the Thursday social and field trips.

Wednesday, April 16

Catamount Bog field trip departs from the front parking circle of the Hyatt at 9:00 a.m.

Catamount Bog field trip	9:00 a.m.-3:00 p.m.
Registration	noon -10:00 p.m.
ASB Executive Committee Meeting	3:00-7:00 p.m.
SABS Council Meeting	4:00-7:00 p.m.
SE Society of Parasitologists Council Meeting	4:00-5:00 p.m.
Presidential Symposium, SE Society of Parasitologists	5:00-7:00 p.m.
ASB Social Hour With Cash Bar	7:30-10:00 p.m.
Continuation of ASB Executive Committee meeting (if needed)	8:00-10:00 p.m.

Thursday, April 17

BBB field trip departs from the front parking circle of the Hyatt Regency at 1:00 p.m.

Past Presidents' Breakfast	7:00-8:00 a.m.
Poster Set-Up	7:00-8:30 a.m.
Registration	8:00 a.m.-5:00 p.m.
General Plenary Session	8:30-9:45 a.m.
Welcome by Dr. David Shi, President, Furman University	
Announcements by Local Committee	
Plenary Lecture, Dr. Nat Frazer, Savannah River Ecology Laboratory	
Exhibits	9:45 a.m.-5:00 p.m.
Paper and Poster Sessions	10:00 a.m.-5:30 p.m.
SWS Luncheon Meeting	12:15-1:45 p.m.
BBB field trip	1:00-5:30 p.m.
Herbarium Curators' Meeting	4:00-6:00 p.m.
ESA Symposium: Vegetation of the	
Southern Blue Ridge Province	
Mixer/Discussion: Recruiting Minority Students in Biology	1:00-5:00 p.m.
Sponsored by ESA/SE Chapter and ASB Committee on Women, Minorities, and the Disabled	
ASIH, SE Division Business Meeting	4:30-5:30 p.m.
SFC Business Meeting	4:00-5:00 p.m.
ASB Social and Barbecue Buffet	5:00-6:00 p.m.
	6:30-10:30 p.m.

Friday, April 18

SABS and BSA, SE Section Breakfast and Bus. Meeting.	7:00-8:30 a.m.
Registration	8:00 a.m.-noon
Exhibits	8:00 a.m.-noon
Paper and Poster Sessions	8:00 a.m.-5:00 p.m.
BBB Paper Sessions and Business Meeting	8:00 a.m.-5:00 p.m.
ASB Business Meeting and Election of Officers	11:30 a.m.-12:30 p.m.
BBB Luncheon	12:00-1:30 p.m.
ESA, SE Chapter Luncheon and Business Meeting	12:30-2:00 p.m.
Symposium: The Importance of Cliff-Face Communities in Plant Ecology	2:30-5:00 p.m.
Workshop: Active Learning and Projected Computer Presentation Packages in Large Lecture Biology Classes Sponsored by the ASB Education Committee	3:00-5:00 p.m.
Social Hour With Cash Bar	6:00-7:30 p.m.
ASB Banquet and Awards	7:30-10:00 p.m.

Saturday, April 19

Field trips depart from the front parking circle of the Hyatt Regency.

ASB Executive Committee Meeting	8:00-10:00 a.m.
Flat Creek Heritage Preserve field trip	8:30 a.m.-5:00 p.m.
Stevens Creek Heritage Preserve field trip	9:00 a.m.-3:30 p.m.
Southeastern Riverine Habitats field trip	9:00 a.m.-4:00 p.m.
Pearson's Falls Glen field trip	10:00 a.m.-3:00 p.m.

GUIDELINES FOR POSTER SESSIONS

Poster sessions have been incorporated as a regular means of scientific presentation at the annual ASB meetings. This type of presentation provides a more informal environment that encourages a direct interchange of ideas and discussion between presenter and audience.

Adherence to the following guidelines will help ensure the effectiveness of poster sessions. Posters will be organized by subject matter and numbered sequentially in accord with abstract listings in the *ASB Bulletin*. Posters will be on display Thursday, 10:00 a.m.-5:30 p.m. and Friday, 8:00 a.m. - 5:00 p.m. Authors are required to be with their poster only from 3-4:00 p.m. each day. A 4' h x 8' wide cloth backed board suitable for thumbtacks will be provided for each presenter.

Posters should be carefully planned to maximize clarity and simplicity in conveying information. Arrange for a heading including a title, author(s), and author(s) institution(s) to be placed at the top in letters no less than three cm high. The body of the poster should be self-explanatory and should include figures, tables, graphs,

maps or photographs displayed in a well organized and coherent sequence from top to bottom. Do not crowd the display. All materials, including text legends and captions on figures or tables, should be legible from a distance of about two meters (use fonts that are at least 18 pt.). Each illustration should be captioned. A limited degree of text can be included, but care should be taken not to overwhelm the audience. Authors may choose to post a large printed copy of the abstract at the top of the poster and include a clear listing of specific conclusions at the bottom.

FIELD TRIPS

Transportation and box lunches will be provided for all field trips. Departures will be from the front parking circle of the Hyatt Regency. If you have questions about any of the trips, contact Wade Worthen at Furman University (worthen@furman.edu; 864-294-3390). Limits for trips may be raised if demand warrants.

1. *Catamount Bog*

Wednesday, April 16, 9:00 a.m.-3:00 p.m.

Catamount Bog is in the Blue Ridge Mountains of northern Greenville County, South Carolina, just minutes from the North Carolina border. Fed by a rock face seepage area, this cataract bog has a variety of habitats supporting sundews and pitcher plants, indian paint brush, bladderworts, grass of parnassus, and grass pinks. It is currently under consideration for designation as a Heritage Trust Site. Leader: Bill Marrell, naturalist, Caesar's Head State Park, SC. Limit: 12. Cost: \$15.00.

2 *Raven Cliff Falls and Caesar's Head State Park (BBB field trip)*

Thursday, April 17, 1:00-5:30 p.m.

Caesar's Head State Park, South Carolina's largest state park, is at the northern edge of Greenville County atop the first ridge of the Blue Ridge Mountains. On clear days, the rocky outcrop near the visitors center provides spectacular views of Table Rock Mountain and the distant skyline of Greenville. After a 2.2 mile walk (mostly easy, some moderate grades) through mixed mesophytic forest, the beautiful cascade of Raven Cliff Falls comes into view, with a total vertical drop of over 100 ft. A spur trail leads to a bridge crossing at the top of the falls. Leaders: Drs. Mary Lang Edwards and Jan Haldeman, Erskine College. Limit: 28. Cost: \$8.00.

3. *Pearson's Falls Glen, Tryon, NC*

Saturday, April 19, 10:00 a.m.-3:00 p.m.

Pearson's Falls Glen is one of the most diverse cove forests in the southeast, remarkable for the diversity of northern species found at this latitude and elevation. The wildflowers are particularly noteworthy and have been written about since the turn of the century. The site is home to five species of *Trillium* and at least eight other species rare to North Carolina. Leaders: Dr. Doug Rayner, Wofford College and Ivan Kuster, local botanist. Limit: 12. Cost: \$15.00 (includes entry fee).

4. Stevens Creek Heritage Preserve

Saturday, April 19, 9:00 a.m.-3:30 p.m.

Dr. Albert Radford (author, *Vascular Flora of the Carolinas*) once called Stevens Creek "...one of the most unique floristic sites in the two Carolinas, and I would rank it as the second most distinguished site in the eastern Piedmont." Between pine dominated ridge-top communities lie north facing bluffs that are home to relic hardwood communities and a variety of wildflowers including locally and federally endangered species such as Florida Gooseberry (*Ribes echinellum*). There are even bald cypress and dwarf palmetto in the floodplain at this unusual Piedmont site. Leader: Dr. John B. Nelson, University of South Carolina. Limit: 12. Cost: \$15.00.

5. Flat Creek Heritage Preserve

Saturday, April 19, 8:30 a.m.-5:00 p.m.

Home to the National Natural Landmark known as "40 Acre Rock", Flat Creek Heritage Preserve also contains dry uplands, floodplains, a beaver pond, cove forests, and waterfalls. The granite of 40 Acre Rock is home to several rare and threatened species, such as pool sprite (*Amphianthus pusillus*), which grow in temporary pools on the rock surface. Leader: Dr. Charles Horn, Newberry College. Limit: 12. Cost: \$15.00.

6. Southeastern Riverine Habitats

Saturday, April 19, 9:00 a.m.-4:00 p.m.

This trip will take participants to a site on the Chattooga River, a typical southeastern Atlantic slope river drainage. The trip will provide many photographic opportunities as well as a chance, for those with collecting permits, to collect fish and other lower vertebrates from a beautiful riverine habitat. Leader: Dr. Dennis Haney, Furman University. Limit: 12. Cost: \$15.00.

7. Joyce Kilmer Memorial Forest/Coweeta Hydrologic Laboratory

Sponsored by the Southeastern Chapter, Ecological Society of America

Saturday, April 19, 8:00 a.m.-Sunday, April 20, 1:00 p.m.

A combination of stops in North Carolina provides participants with an opportunity to observe both pristine and managed forests. Since 1934, scientists with the US Forest Service at Coweeta have studied climate and streamflow while monitoring the effect of timber harvests and forest changes in an array of experiments. After visiting Coweeta's outdoor laboratory, participants will hike along the gentle trails of Joyce Kilmer Memorial Forest; a moist cove forest most noted for its pair of record sized tulip poplars. Overnighting at a motel or lodge, the group will return to Greenville via the Blue Ridge Parkway and Pisgah National Forest. Leader: Dr. William Teska, Furman University. Limit: 12. Cost: \$20.00. Price includes transportation only. Participants will pay for food and motel accommodations during the trip. Contact will be made prior to the trip regarding individual accommodation requirements. For further information, contact the trip coordinator, Dr. Niki Nicholas (423-632-1676; nnicholas@TVA.gov).

ON YOUR OWN: OTHER FIELD TRIP/TOURIST DESTINATIONS

1. *BMW Zentrum*: Greenville is home to the U.S. Headquarters of BMW. They have a display room that is open to the public. (North on I-85 to exit 60, cross bridge, left at light, left at second light. About 30 min. from downtown. Admission: adult, \$3.50, seniors, \$2.50, children, \$2.00. Open Tuesday-Saturday, 9:30 a.m.-5:30 p.m.)
2. *Greenville Zoo*: This small zoo is an excellent place to spend time, by yourself or with the kids. In addition to "Joy" the elephant, the zoo is home to Sundari the white tiger and a pair of goanna lizards. The small herpetarium will be a sure hit. (Located in Cleveland Park: South on Main St., turn east on Washington St. About 10 min. from the Hyatt. Admission: adult, \$4.00, children ages 3-15, \$2.00, under 3, free. Open every day 10 a.m.-4:30 p.m.).
3. *Furman University*: Enjoy a walk around the lake or through the rose garden on this beautiful campus. (North on Business 25 to Furman exit. About 15 minutes from downtown; free).
4. *State Parks in the area*:

Paris Mountain State Park: Have a picnic or walk around the lake. (North on US 25, right on 291 south, quick left onto State Park Road (SC 253). About 20 minutes from downtown.)

Jones Gap State Park: Another nice site for a picnic or walk A bit less impacted than Paris Mountain State Park. (North on US 25 to US 276 N; right at cut off to Park and Rte. 11. About 30 minutes from downtown.)

Table Rock State Park: Many nice walks along streams that skirt Table Rock Mountain, or hike to the top. (North on US 25 to US 276 N; 276 N to US 11 west. About 45 minutes from downtown.)

Caesar's Head State Park: A great overlook of North Greenville County and a terrific view of Table Rock. Also a gradual 2.0 mile hike to Raven Cliff Falls. (North on Business 25 to US 276 N up to the top of the mountain. About 50 minutes from downtown. Falls parking lot is beyond the Park entrance on the right, at curve.)

LOCAL ARRANGEMENTS COMMITTEE

Local Arrangements	Lew Stratton (864) 294-3249; lew.stratton@furman.edu
Program and Audiovisuals	Joe Pollard (864) 294-3244; pollard@furman.edu
Social Arrangements	Irene Kokkala (864) 294-3245; kokkala@furman.edu
Commercial Exhibits	John Snyder (864) 294-3248; john.snyder@furman.edu
Field Trips	Wade Worthen (864) 294-3390; worthen@furman.edu
Registration	Laura Thompson (864) 294-2085; laura.thompson@furman.edu
Meetings Statistics	Bill Blaker (864) 294-3084; blaker@furman.edu
Conference Organizer	Helen Stratton (864) 294-3083; helen.stratton@furman.edu
Host Institution/Department	Furman University Biology Department 3300 Poinsett Highway Greenville, SC 29613-0418 (864) 294-2084 fax: (864) 294-2058 www.furman.edu/~pollard/ASB/
Meeting Headquarters	Hyatt Regency Greenville 200 North Main Street Greenville, SC 29601 (800) 233-1234 (864) 235-1234 fax: (864) 370-9204

**58th Annual Meeting Hosted by Furman University
Greenville, South Carolina April 16-19, 1997**

PRE-REGISTRATION FORM

(Type or clearly print one form per registrant)

Name

☐ Faculty ☐ Graduate Student ☐ Undergraduate Student

Institution

Mailing Address

City State Zip

Office Phone ()

Email

**Affiliation (check
where appropriate):**

☐ ASB	☐ ASIH	☐ BBB	☐ BSA	☐ ESA
☐ SFC	☐ SABS	☐ SSP	☐ SWS	

Pre-Registration fee:

Regular: \$50.00 \$ _____

Student: \$20.00 \$ _____

Late registration: Regular \$65.00; Student \$25.00

Wednesday Evening ASB Social:

I plan to attend ☐

Thursday Evening BBQ Buffet:

Regular: \$25.00 x ____ tickets \$ _____

Student: \$20.00 x ____ tickets \$ _____

☐ I will require assistance with transportation to the buffet
(0.4mi walk).

Friday Evening ASB Banquet:

Regular: \$35.00 x ____ tickets \$ _____

Student: \$25.00 x ____ tickets \$ _____

Entree preference: # fish ____ # poultry ____ # vegetarian ____

Breakfasts:

ASB Past Presidents	\$16.00 x ____ tickets	.....	\$ _____
SABS/BSA	\$16.00 x ____ tickets	.....	\$ _____
Executive Committee	\$16.00 x ____ tickets	.....	\$ _____

Luncheons:

Beta Beta Beta	\$ 8.00 x ____ tickets	.....	\$ _____
ESA/SE Chapter	\$18.00 x ____ tickets	.....	\$ _____
SWS	\$18.00 x ____ tickets	.....	\$ _____

Field Trips:

1. Catamount Bog	\$15.00 x ____ tickets	.....	\$ _____
2. BBB - Raven Cliff/Caesar's Head			
	\$ 8.00 x ____ tickets	.....	\$ _____
3. Pearson's Falls	\$15.00 x ____ tickets	.....	\$ _____
4. Stevens Creek	\$15.00 x ____ tickets	.....	\$ _____
5. Flat Creek	\$15.00 x ____ tickets	.....	\$ _____
6. Riverine Habitats	\$15.00 x ____ tickets	.....	\$ _____
7. Joyce Kilmer/	\$20.00 x ____ tickets	.....	\$ _____

Coweeta (Price includes transportation only. See description in *ASB Bulletin*.)

Total Amount Enclosed \$ _____

Make checks payable to: 58th ASB Meeting

Pre-registration deadline March 31, 1997

Mail pre-registration form and check to:

Dr. Lew Stratton
Biology Department
Furman University
3300 Poinsett Highway
Greenville SC 29613-0418

OBITUARY

DR. EMMA LEWIS LIPPS

Shorter College paid tribute to Dr. Emma Lewis Lipps during a Memorial Service on 17 September 1997. Dr. Lipps died at the age of 77 on July 19, 1996.

Dr. Lipps' influence was far-reaching. She taught at Shorter over 40 years, joining the Shorter faculty in 1944. When Dr. Lipps began teaching, ecology was little known outside academic circles, but throughout her career she sought to make people aware of their dependence upon and responsibility to the planet. In her 45 years of teaching she helped train two generations of students who have carried the ecological message far and wide and was a major professor for many who established careers in the medical field. In 1979 the national Council of State Garden Clubs honored her for her 25 years of effort on behalf of the Marshall Forest. She was instrumental in having the 250 acre forest designated as Georgia's first natural national landmark.

Her ecological interests were also reflected in her geological work at Ladd Quarry in Bartow county, where in 1968 *Smithsonian Torch* reported the discovery on this site of the largest Devonian fossil fauna ever found in the Southeast. Dr. Lipps and her students sent enough fossils to fill several drawers in the workrooms of the Smithsonian Institute.

Dr. Lipps retired in 1989 as Distinguished Professor of Biology and Earth Science emerita. Upon her retirement Shorter college established the Lewis Lipps Ecology Lectureship series. The Lipps-Greear Scholarship was also established in honor of Dr. Lipps and Dr. Philip Greear, Professor of Biology and Earth Science Emeritus, who invested the majority of their lives to the educational experience of Shorter students.

Contributions may be made in memory of Dr. Lewis Lipps to the Lewis Lipps Ecology Lectureship and to the Lipps-Greear Scholarship Fund. Gifts should be sent to Gifts Receiving Officer, Shorter College Box 5, 315 Shorter Avenue, Rome GA 30165-4298.

ANNOUNCEMENTS

THE CHIRAL CONFERENCE OF THE AMERICAS 11-14 JUNE, 1997, WESTIN REGINA RESORT, CANCUN, MEXICO

The Chiral Conference of the Americas will focus on pharmacological aspects of chirality, enantioselective separation (including preparative,) enantioselective synthesis, and chiroptical spectroscopy. For more information contact Ms. Mary Jo Richards or Dr. Daniel W. Armstrong, Department of Chemistry, University of Missouri-Rolla, Rolla, Missouri, USA, telephone (573)341-4492, fax (573)341-6033, email: mrichard@umr.edu or access the internet at: <http://www.umr.edu/~chiral>.

**NORTH AMERICAN BENTHOLOGICAL SOCIETY
45th ANNUAL MEETING**

The 45th Annual Meeting of the North American Benthological Society will be held on the campus of Southwest Texas State University in the city of San Marcos, Texas on May 26-30, 1997. The program features four days of invited and contributed presentations and workshops on the structure and function of benthic communities in aquatic ecosystems. The Plenary Session of the meeting will be: "Aquatic Endangered Species: Their Role in Ecosystems and Water Quality and Quantity Issues." Some special sessions include: "Macroecology in Aquatic Ecosystems", "Environmental Problem Solving", "Ecology of Karst Aquatic Ecosystems", "Urban Rivers" and "Systematics and Ecology of Aquatic Invertebrates." Workshops are planned on: "In-stream Flow Determinations" and "Communications Skills for Benthic Ecologists: the Public, Media, State, and Federal Agencies as Audiences." For more information contact:

Dr. Tom Ausuffi, Program Chair
Department of Biology – Aquatic Station
Southwest Texas State University
San Marcos, TX 78666
(512)245-2284, FAX (512)245-7919

Dr. Glenn Longley
Local Arrangements Chair
Edwards Aquifer Research and
Data Center
Southwest Texas State University
San Marcos, TX 78666
(512)245-2329, FAX (512)245-2669

**ASC SURVEYS OF RESEARCH SYSTEMATICS COLLECTIONS AND
INDIVIDUAL TAXONOMIC RESEARCHERS: YOUR PARTICIPATION IS NEEDED**

The Association of Systematics Collections has developed a **Survey of Research Systematics Collections and Information**, the results of which will be made available to users of systematics resources over the world wide web. We hope that your Collection will participate in the survey, so that information about your Collection and its resources can reach colleagues worldwide. Participation in the database will give your institution higher visibility with government agencies and the public, and may lead to new opportunities. It will help ASC document needs and develop policy options for support of collections by governments and the private sector.

This on-line database is a modern approach to providing the same kind of data ASC has collected in the past. In fact, responses to this survey will eventually become part of a longitudinal series of data. You may respond to the survey by contacting ASC for a form, filling it out and mailing or faxing it back, or **PREFERABLY**, you may go to <http://www.ascoll.org/SURVEY/>, the ASC's web site, download the survey, fill it out, and send it to ASC. Each administratively separate collection is to complete the survey and return it to ASC.

This database is one of two that are sponsored by the Biological Resources Division of the USGS in cooperation with a group of six federal agencies and the Smithsonian-NMNH, which compose the Interagency Taxonomic Information System (ITIS). Many federal agencies and other resource management organizations have a strong need for taxonomic information or services that are credible and readily accessible.

The first database, the **Taxonomic Resources and Expertise Directory (TRED)**, has also been distributed, and the responses are now being entered into the database. TRED is designed to contain information about individual systematists and taxonomists needed by those seeking

taxonomic expertise. It will be available for searching at <http://www.itis.usda.gov/itis> on the Internet. If you have not provided data for the TRED, it is not too late. Please call up the ASC web site for information and a copy of the survey.

Send the completed Research Systematics Collections survey and TRED forms to:

The Association of Systematics Collections
1725 K St. NW Suite 601
Washington, DC 20006-1401

FAX: (202)835-7334
Phone: (202) 835-9050
Email: asc@ascoll.org

REVIEWS

Bartlett, A.B. 1995. **Troubled Waters: Champion International and the Pigeon River Controversy**. Univ. Tennessee Press, Knoxville, TN. \$17.95 paper, \$35.00 cloth.

A large pulp and paper mill was established on the upper reaches of the pristine Pigeon River in the Appalachian Mountain region of western North Carolina in 1908. For almost 90 years the river below this mill has received contaminated effluents from the Champion International facility in Canton, NC. This book is a chronology of the complex history of Champion International and the Pigeon River as a few citizens of Tennessee fought and struggled to force the corporate giant to clean up the river. The first chapter of this book provides the setting of the Pigeon River controversy as it relates to the pollution of the river by Champion. The initial chapters present a delightful early history of the Western North Carolina-East Tennessee region regarding its economy and the series of events that eventually led to this mill being placed in its present location. The majority of the book deals with the legal battles and not so legal controversies that raged, sometimes to spirited and emotional highs, between Champion and the citizens of Tennessee, regulatory agencies of both states, and the Environmental Protection Agency. Through a long series of law suits including local and evidentiary hearing, the author relates how the determination and persistence of a few committed individuals, bent on protecting their environment, eventually forced the corporate giant to spend millions, and sometimes tens and hundreds of millions, in initiating efforts to clean up the river.

Richard Bartlett has used an interesting array of details and facts to present the history of the struggle for a clean environment using the words and documented actions of participants at various levels of the controversy. Even though the book may appear on first consideration to be a scathing condemnation of Champion's unethical practices through the decades, the author has attempted to remain unbiased and has presented a fair case for both sides of the debate. The sheer weight of the accumulated evidence, however, supports the authors position and the facts speak for themselves. The author points out that in each major instance when the paper company was challenged with major environmental regulation that they perceived as an expensive endeavor, the standard defensive response came to be that many employees of the paper mill (in most cases hundreds) would lose their jobs thereby throwing western North Carolina into an economic depression via the domino effect.

The case study of the Pigeon River is more, however, than just the chronology of long battles between a large corporation and individual citizens over environmental issues. The

Pigeon River story reminds us that the time for environmental reason and action is at hand, and as competition for natural resources increases and our environment becomes more vulnerable to anthropogenic stressors, all of us should be challenged to be responsible stewards of our planet. We as a society should be past the point of addressing only resource use and abuse, but should also be concerned with the moral and ethical responsibility that goes along with protecting these resources. The public is beginning to wise up to the sometimes industrial mentality of "pollution for profit" and this book exposes the history of this mentality in the specific case of the Pigeon River. I highly recommend this book to all who have a concerned interest in the environment and need to be encouraged that determination and persistence can, when applied in an appropriate manner, be an effective deterrent to corporate wealth and influence when the quality of our environment is at stake.

S. MARSHALL ADAMS, *Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831.*

Evans, M.I. (ed.). 1994. Important Bird Areas in the Middle East. Birdlife Conservation Series No. 2. Birdlife Internat. Cambridge U.K. and Smithsonian Inst. Press, Washington, DC. \$32.00. 410p.

This book is one of five in a series that addresses various aspects of global bird conservation. I have seen only two of these - the one sent to me for review and another edited by D. N. Nettleship, J. Burger and M. Gochfeld entitled *Seabirds on Islands: Threats, Case Studies and Action Plans*. Both are comprehensive documents that make the maximum amount of up-to-date information available. The organization of both books is exceptional. Readers can easily obtain factual information and find the original source(s) on either a geographic area or a particular species. So many of the current texts that deal with conservation issues, in general, contain only a few specific examples and have limited factual information. This is a good series to study, even if birds *per se* are not the focus of your academic interest. One would be hard pressed to find better models for addressing conservation problems of a geographic region or a taxonomic group.

The text of the *Important Birds Areas in the Middle East* was prepared by 57 primary contributors. Their collective contribution is international in scope and it is important to note that Middle East ornithologists can work cooperatively on kindred concerns even if the nations in which they live cannot.

The book starts with a well-written introduction that defines the aims of the publication. The bulk of the text is an inventory of important sites for long-term bird conservation in the Middle East and the introduction provides a list of six specific functions of this inventory. Again this book is about birds, but the framework could be used for the organization of almost any broad-scale conservation strategy.

A chapter on site selection explains the site categories and gives summaries in table form for species of concern, showing the total numbers of breeding pairs and the regions where each occurs. Several other short chapters explain how the data is presented and give overviews and recommendations. The majority of the text consists of specific chapters on each of 14 nations in the Middle East. Chapters vary in lengths and, as one would expect, also have considerable variation in their depth of coverage. This is in part because of the different sizes of the countries, differences in conservation priorities, and different levels of local knowledge, or interest in birds in each country. The chapter on Iran is particularly well done so I'll use it to illustrate the text layout. A half page of general information (area, human population, and ecological overviews) is followed by eight detailed descriptions of

specific habitats. The countries conservation infrastructure is explained and an overview of the inventory follows. One hundred and five sites totaling an area of 87,000 km (5% of the area of the country) are considered as priority sites for bird conservation in Iran. Coverage of all the major habitat types important to birds is considered by the authors to be good. The more extensive and homogeneous habitats, such as deserts and steppes, are protected at a number of representative sites.

This information is followed by a table showing the criteria used to select each site. There are several pages of specific comments on the inventory and a coded map showing their locations within Iran. This is followed by 81 pages of text on the individual sites. These descriptions include the name of the site, amount of private or government protection received, latitude/longitude location, site size, detailed site description, an overview of the birds using the area and a highlighted box discussing globally threatened birds. Bird species are listed when more than 1% of their population use the site. For these the number of pairs breeding, wintering, and the numbers passing in migration are estimated. Regionally threatened or declining species are listed separately. Endemic and other threatened wildlife at the site are discussed, along with conservation issues, and suggestions for further reading. The format allows for easy comparisons from site to site and country to country.

Highlighted boxes allow the reader to quickly tally the population of any species throughout the Middle East with the threatened and endemic species having the most detailed coverage.

While I am clearly not familiar with the fauna of this region I was able to use this book to quickly tabulate the populations of several species of seabirds for which I am currently preparing accounts for the Birds of North America project (A.O.U. and Philadelphia Academy of Sciences). In most cases the information available in this book was the only compiled up-to-date information available for the 14 countries in their area of coverage.

Several appendices are included, one of which is a quick index to sites where globally threatened birds occur. There is a lot of information in this book and Birdlife International has demonstrated the importance of making it available not just to ornithologists, but allowing its significance and comparative importance to be understood by people making land planning decisions. Furthermore, here their approach of identifying and protecting key areas, vs a focus on individual species is, as we are slowly learning, a much more valid conservation strategy.

Here in the U.S. many similar attempts are squirreled away in generally inaccessible computer data banks, and when available to biologists, land planners or the general public their contents are usually filtered. Furthermore, most of the more massive overview type inventories are so cluttered with coded priority categories and overlapping terminology that even people working closely with conservation programs are confused. Here in North Carolina we not only have federal listings (Endangered, Threatened, Categories I and II) and state listings (Endangered, Threatened, Special Concern) that are legal definitions and supported by regulations, but we also have a long list of additional terms used by state agencies and private conservation organizations (for example - Vulnerable categories I and II, State Listed, Rare, Peripheral, globally endangered, depleted, not formally listed, and undetermined). For migratory birds we even have rankings of concern allowing land managers to prepare total scores by adding birds from various taxonomic groups and habitat types. People writing popular accounts for newspapers, the public, and even biologists that have helped generate this mess (hey, I'm guilty) are confused. We become incensed when bureaucrats and land owners do not support endangered species legislation and critical habitat regulations. Our problem is simple. No one understands us. The resulting additional problem is that environmentalists trying to promote a particular point can now pick and

choose from an arsenal of legal, biopolitical, scientifically credible terms and untested nonsense to strengthen points they wish to make.

I like the format of the Middle East book - it makes its point with simple and easily understood consistent terminology. When compared to our U.S. efforts the Middle East compilation should make all of us question why we continue to address conservation issues in such a complicated indirect manner.

DAVID S. LEE, *NC State Museum of Natural Sciences, Raleigh, NC 27626.*

Nettleship, David N., Joanna Burger and Michael Gochfield (Eds.) 1994. Seabirds on Islands: Threats, Case Studies and Action Plans. Birdlife Conservation Series No. 1. Birdlife International. paperback \$32.00. 318p.

This is a compilation of studies from the Proceedings of the Seabird Specialist Group Workshop held at the XX World Conference of the International Council for Bird Preservation, University of Waikate, Hamilton, New Zealand, 19-20 November 1990. The contents are divided into five sections (number of papers in each in parenthesis): Introduction (1); Threats to Seabirds (3); Major Seabird Problems (10); Action Plans; Progress and Solutions (5); and Conclusions and Actions (1). Each paper begins with a summary and ends with conclusions. Humans in one way or another (e.g. overfishing, introducing feral animals or altering the landscape) have had a detrimental effect on seabirds and their rookeries the world over. Problems are easily defined, solutions are not readily apparent. G. C. Duffy, who contributed two papers during the workshop, makes the plea in the concluding chapter for a seabird secretariat similar to that of the International Whaling Commission. He believes a secretariat for seabird preservation could accomplish the following: (1) facilitate exchange of information on research techniques and management of seabirds; (2) monitor data from various sources to detect emerging threats and vulnerable species; (3) coordinate the logistics of programs addressing such local issues as eradication of feral animals; (4) help ensure the inclusion of seabirds in international treaties and laws; and (5) assemble human and financial resources to achieve these goals. This publication is a must for the serious student of marine ornithology and an informative and easily readable series of studies for the layman interested in birds.

WILLIAM S. WOOLCOTT, *Professor Emeritus, Department of Biology, University of Richmond, Richmond, VA 23173.*

Janick, Jules, ed. 1994. Plant Breeding Reviews, Volume 12. John Wiley & Sons, West Sussex, England. \$110.00. 315p.

Dedicated to Robert W. Allard, this volume reviews *Bacillus thuringiensis* and its use as a biological insecticide; development of virus resistant plants via engineering; carbon isotope discrimination and plant breeding; *in vitro* adaptation for drought and cold hardiness in wheat; the ideotype concept and the genetic improvement of tree crops; application of DNA markers for identification and breeding of perennial fruit crops; heterosis in plant breeding; breeding of seed-planted artichoke; and concepts and methods for analyzing regional trial data for cultivar and location selection.

The dedication to Dr. Allard is presented by Michael T. Clegg who sums up Allard's outstanding contribution to plant biology: "Bob Allard's fundamental investigations of plant population genetics have focused on the enormous influence of interactions among genes, genotypes, and even organisms in determining the genetic architecture and adaptive potential of plant populations. The lesson for crop improvement in agriculture is that complex biological systems do not easily lend themselves to simple reductionist approaches. The role of plant breeding must be to exploit these complex interactions in useful ways." A bibliography of R. W. Allard is at the close of the dedication.

This volume provides information on a variety of fascinating subjects of interest to plant breeders and biologists in general. The editor has ensured that each chapter presents information succinctly and in a manner that can be understood. The bibliographies at the end of each chapter are extensive. Those ASB members who teach will find ample information for both the general and advanced biology classes. Others will be able to keep abreast beyond just superficial knowledge about the subjects. This volume should have a place of honor on the biologist's bookshelf.

NANCY C. COILE, *Division of Plant Industry, Florida Department of Agriculture and Consumer Service, Gainesville, FL 32614-7100.*

CIBA Foundation Symposium #193. 1995. *Development of the Cerebral Cortex.* John Wiley & Sons, NY. \$79.95. 300p.

The neo-cortex is a paradox. On the one hand it is very simple, constructed with a small number of distinct cell types arranged into laminae. On the other hand it is very complex since, in spite of the homogeneity of the basic structure, there are notable regional differences. These regional differences reflect variations in the size of the cells, their connections with different parts of the thalamus and neo-cortex and the thickness of the various laminae. One of the principal tenants of neuroscience is that form reflects function, therefore, the regional differences in the structure of the neo-cortex are presumed to be important indicators of regional differences in cortical function.

The 193rd Symposium sponsored by the Ciba Foundation was organized to delve into the manner in which regional differences in cortical structure develop. Held in late 1994, this symposium brought together researchers from very diverse backgrounds, who bring to bear a number of different technical and philosophical approaches on the problem of understanding how the brain is assembled. This report of the symposium is divided into five parts with several chapters in each. A sometimes lively discussion follows each chapter and further discussions conclude each major section. A final discussion in which the participants wrestle with the terms "specification" and "determination" concludes the symposium. So important are these terms that I would recommend that those unfamiliar with their use in the specific context of brain development read that discussion before attempting any of the other chapters. An excellent introduction by Colin Blakemore reviews the major trends in this field from the time of Descartes to the present.

The first section of the symposium takes up the problem of cell migration, clones, and lineage. Considerable evidence, based on the use of retrovirus probes, was presented that demonstrates that horizontal migration of progenitor cells occurs before radial migration. A hypothesis relating certain congenital brain diseases to disruptions in horizontal migration is presented. The second section deals with the origins of cortical cell diversity. Excellent chapters discuss growth factors and homeobox genes that affect cell diversity in mammals.

Various problems pertaining thalmo-cortical interactions are addressed in the third section while neocortical plasticity is the subject of the fourth. Finally, the symposium is concluded by two very interesting papers that review the evidence that schizophrenia and some rare forms of epilepsy may be, in fact, the result of developmental errors.

This book will be valuable to the student new to the field. It will also be of great utility to any neuroscientist who wants to be quickly brought up to date in this rapidly moving and interesting field. The bibliographies at the end of each chapter and the well constructed index are excellent.

ROBERT E. KINGSLEY, *South Bend Center for Medical Education, Indiana Univ. School Medicine, Notre Dame, IN 46556.*

NEWS OF BIOLOGY IN THE SOUTHEAST

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ABOUT PEOPLE AND PLACES

GEORGIA

Savannah River Ecology Laboratory, The University of Georgia. "Population Dynamics in Ecological Space and Time" was released by the University of Chicago Press. The book is a 10-chapter volume produced from the first in a series of Savannah River symposia on Environmental Sciences. The chapters in the book were edited by *Drs. Olin E. Rhodes Jr.* of Purdue University, *Ronald K. Chesser* and *Michael H. Smith*, both of SREL. Part I discusses the expansion of population and genetic concepts in time and space. Part II addresses some of the strategies that species have developed to deal with spatial and temporal variation in resources or reproductive opportunities. Part III considers the effects of dispersal patterns and population organization on the distribution of genes across the landscape, while Part IV focuses on the effects of decreased biodiversity, accelerated habitat loss and increased concentrations of human-introduced toxins on ecological communities. the symposium that produced this information was organized by the SREL, and funded by the DOE and The University of Georgia.

KENTUCKY

Eastern Kentucky University, Department of Biological Sciences. Dr. Branley Branson, ichthyologist and natural historian, has retired after 31 years of service. She was honored in April at a banquet hosted by colleagues, former students and friends. The department's zoological museum collection has been designated as the Branley A. Branson Museum of Zoology. She was also instrumental in starting the department's graduate program. Dr. Raymond Otero, a clinical microbiologist also retired with 28 years of service. Dr. Otero is now a full-time consultant with Smith/Kline Beecham. Dr. Marcia Pierce (Ph.D. microbiology, University of New Hampshire) has accepted a tenure-track assistant professor position in the department. Patrick Ceas (Ph.D. candidate, University of Illinois) has also joined the faculty as tenure-track assistant professor. His research focuses on the systematics of freshwater fishes of the central highlands of eastern U.S. Dr. Gary Ritchison, ornithologist, is continuing his studies of mating strategies of yellow-breasted chats and white-eyed vireos while on sabbatical in Fall 1996. Dr. William Farrar, structural biochemist, has recently received a grant to continue his work on structure and function of enolases.

Morehead State University, Department of Biological and Environmental Sciences. Dr. David Brumagen, Mr. Fred Busroe and Dr. Howard Setser have all taken early retirements effective Fall 1996. They will continue work on floristic research with both Bryophytes and vascular plants and directing the herbarium. Dr. Joe Winstead has assumed the position of Chair after completing 28 years at Western Kentucky University. The department will be seeking to fill five tenure track positions in biology and environmental science for the 1997-98 academic year.

MISSISSIPPI

Delta State University, Biology Department. Dr. Sherri L. DeFauw, Associate Professor of Biology, joined the faculty in the Fall of 1996. She comes from McPherson College in Kansas. Dr. DeFauw's research interests include salamander systematics, herpetofaunal surveys and ecotoxicology. Dr. Grady W. Williams, Professor of Biology, was honored by the Mississippi State Legislature for his contributions in biology and education. Dr. Malcolm K. McEwen, Associate Professor of Science Education, received his Ed.D in science education from West Virginia University last Fall. this summer, Dr. McEwen represented the Mississippi Science Teachers Association at a meeting of National Science Teachers Association in Flagstaff, Arizona. Dr. William Hayes and Dr. Samuel Faulkner attended NSF-sponsored biology workshops in Virginia and Oregon during the summer. Dr. Malcolm McEwen also attended the Oregon meetings. Mrs. Elizabeth Peeler, Assistant Professor of Biology, retired after the Spring 1996 semester. She and her husband plan to move to the Carolinas in the future. The Biology Dept. became an affiliate institution of the Reis Biological Station Consortium in the Missouri Ozarks. Several faculty plan to offer field courses at Reis in the near future.

Mississippi University for Women, Division of Science and Math. In the Spring of 1996, the U.S. Army Corps of Engineers turned over control of the newly built Plymouth Bluff Education Center, to MUW. The Center is a science education and professional development center. The 140 acre site on the old channel of the Tombigbee River is approximately five miles from downtown Columbus. It houses an education center with a 100-seat auditorium, dining center, and education laboratories along with six cabins which can accommodate up to 48 persons. The main building in the Center is named the *Harry Logan Sherman* building, in honor of Dr. Sherman (former head of the Science/Math Division) who almost single handedly kept after the Corps to build the center, which they had proposed in the middle 1970's. Dr. Sherman is an Administrative Assistant at the Center.

NORTH CAROLINA

East Carolina University, Department of Biology. Dr. Cindy Putnam-Evans has been awarded an NSF \$180,000 grant for her 3 year research project entitled, "Mutagenesis Studies to Probe the Function of the Large Extrinsic Loop of the CP-43 Apoprotein of Photosystem II." Dr. Lisa Clough (Biology and Institute for Coastal and Marine Resources), a benthic ecologist was featured on the two-hour documentary film, *Icebreaker to the North Pole* which aired on the A&E TV network. Dr. A. C. "Trip" Lamb was awarded an \$18,600 grant for his research "Herpetofaunal Inventory of the Lower Roanoke River." Drs. Richard Rheinhardt and Mark Brinson received an \$83,064 grant for their research "Restoration Potential for Small Streams in the Coastal Plain of North Carolina." Mr. John Darrow led a computer Bio-lab session at the Seventh Technology Teaching Conference in Greenville, NC. Dr. Kenneth Morgan received an Award for his research, "Ventilatory Accommodation of changing Oxygen Requirement in the European Hedgehog." Mrs. Linda Singhas has been re-hired to teach Human Anatomy and Physiology. Dr. Christopher Nelson Sinback, Assistant Professor, and a physiologist, was hired to teach Human anatomy & Physiology and Principles of Biology I. Dr. W. Lee Williams, Ph.D. in Medicinal Chemistry joined the faculty and will be teaching Principles of Biology. Mr. Rufus "Rusty" Gaul, was hired in the position of Lecturer to coordinate and teach the multi-lab sessions of Environmental Biology. Dr. Clifford Knight is starting his 41st year of meritorious service to the department and University. Other faculty cited for completing 30+ years of service include Francis P. Belcik, Vincent J. Bellis and Prem Sehgal.

Brevard College, Division of Mathematics and Natural Science. Dr. Larry Ragsdale, formerly of *Emory University*, joined the faculty as Dalton Chair of Environmental Studies. Dr. Ragsdale is responsible for the development and all aspects of the new interdisciplinary environmental studies program. Brevard College recently moved from two-year to four-year status.

SOUTH CAROLINA

Newberry College, Department of Biology & Chemistry. Mr. George Renwick has retired after 22 years of service at the college. He continues in a part time capacity as Director of the State Science Olympiad and Newberry College Academic Challenge. Dr. Charles Horn is the new department chair and continues as curator of the herbarium, which now numbers over 11,000 specimens. Dr. Horn has also received a grant from the Smithsonian Institution to continue studies on aquatic plants in the Rupununi Savanna region of Guyana, South America. The department has now initiated a major in Veterinary Technology, a first for the southeast.

Wofford College, Department of Biology. Dr. David I. Kusher joined the department as Assistant Professor of Biology. He received his Ph.D. in Zoology at the University of Georgia and has done post-doctoral research at *H. Lee Moffitt Cancer Center and Research Institute and All Children's Hospital, University of South Florida.*

TENNESSEE

Tennessee Technological University, Department of Biology. Dr. Felix G. Coe joined the faculty as Assistant Professor of Biology. He came from the University of Connecticut, where he received his Ph.D. in Botany. His research interests are in the areas of systematics of vascular plants, floristics, economic botany and ethnobotany. He is also in charge of the Hollister Herbarium.

Erratum

The News of the Southeast article in the October issue of the *ASB Bulletin* concerning East Carolina University should have read as follows:

East Carolina University, Department of Biology. Dr. Charles E. Bland, chairman for the past 16 years, has decided to step down. A Search Committee for a new chairman has formed headed by Dr. Carson Bays, chair of Economics. Dr. Terry West and Dr. Lisa Clough received a \$27,000 PCS Phosphate grant, for research entitled "Infaunal Community Structure, Sediment Geo-chemistry and Biologically Available Protein in Mitigated and Natural Oligohaline Sites in Beaufort County, North Carolina." Ms. Annette Rogers has filled the Biology Laboratories Manager II Position. Both Drs. Alfred Trip Lamb and Thomas McConnell received tenure and promotion to Associate Professor. Dr. Kyle Summers was featured in an episode of the PBS-TV series Hidden Worlds. (National Geographic).

POSITIONS AVAILABLE

BIOLOGIST

Mississippi University for Women, the first public college for women and nationally recognized for its excellence in undergraduate education, announces a search for a biologist. Tenure track, assistant professor rank, beginning August 1997. Ph.D. and evidence of excellent teaching experience required. Responsibilities include teaching cell/molecular biology, botany and general biology courses and student advisement at undergraduate level. Send letter of application, resume, transcripts, and five references to Office of Personnel, MUW, P.O. Box W-1609, Columbus, MS 39701. AA/EOE.

ASSISTANT PROFESSOR

Entry level tenure track position, Ph.D. required. Responsibilities include: teaching an upper-level undergraduate survey course in entomology with emphasis on field experience; participation in general biology program; teaching graduate classes in entomology and related areas; serving as a mentor for undergraduate research and Master's theses; seeking extramural funding. Research expertise in areas such as plant-insect and/or host-parasite interactions, forest entomology, systematics or biological control; use of molecular techniques would complement other departmental research activities. Send letter of application, *curriculum vitae*, description of research interests, names, addresses and telephone numbers of three references to Dr. Douglas Meikle, Chair, Department of Biology, Appalachian State University, 572 Rivers St., Boone, NC 28608. Telephone: (704)262-3025. Completed applications due by Jan. 15, 1997. Appalachian State University is an Equal Opportunity Employer.

Advertisements for positions will run on a space-available basis. Usually, the material should be to the editor at least two months before the next issue is due to be published.

WORKSHOP ADDED DURING PROOF

Application of Recent Technological Advances to Plant Mating Studies. Sponsored by BSA, SE Section. Friday, April 18, 8:00 - 11:00 AM.

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Please complete the information below, enclose check or money order payable to **Association of Southeastern Biologists**, and mail to Gerhard Kalmus, Department of Biology, East Carolina University, Greenville, NC 28785, (919)328-6306. The mailing label shows the year through which you are paid -- for example, if the date is 1996, you need to pay for 1997 and 1998. Please contact Gerhard Kalmus if there is an error. Thank you for your support.

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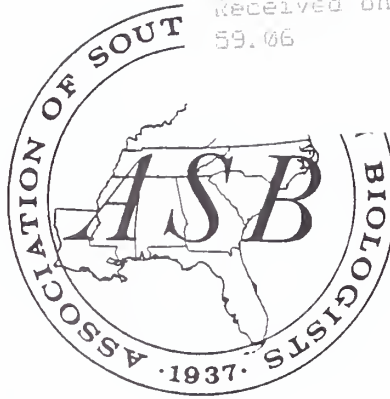
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IN THIS ISSUE
THE ASB BULLETIN
Volume 44, Number 1, January 1997

A MESSAGE FROM THE PRESIDENT	1
58TH ANNUAL MEETING	3
Societies Meeting With ASB In Greenville	3
Furman University and Greenville	3
Travel To and Within Greenville	4
Accommodations	4
Pre-Registration and Registration	5
Local Arrangements Committee	11
PRE-REGISTRATION FORM	12
OBITUARY	14
ANNOUNCEMENTS	14
REVIEWS	17
NEWS OF BIOLOGY IN THE SOUTHEAST	22
ERRATUM	25
POSITION AVAILABLE	26

Cover photo by Ruth and William Dewel
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The ASB BULLETIN

Volume 44, Number 2

April 1997



Furman University, Greenville, SC, Host of the 58th Annual Meeting

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The purpose of this Association shall be to promote the advancement of Biology as a science by encouraging research, the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. Members receive the Bulletin.

TIME AND PLACE OF FUTURE MEETINGS

1997	April 16-19	Furman University, Greenville, SC
1998	April	Northeast Louisiana University, Monroe, LA
1999	April	University of North Carolina at Wilmington, Wilmington, NC

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Program of the
58TH ANNUAL MEETING of the
ASSOCIATION OF SOUTHEASTERN BIOLOGISTS
April 16-19, 1997

Hosted by:

FURMAN UNIVERSITY, DEPARTMENT OF BIOLOGY

at

Hyatt Regency Greenville
220 North Main Street
Greenville, South Carolina

Societies Meeting With ASB In Greenville:

American Society of Ichthyologists and Herpetologists,
Southeastern Division (ASIH)

Beta Beta Beta (BBB)

Botanical Society of America, Southeastern Section (BSA)

Ecological Society of America, Southeastern Chapter (ESA)

Society of Wetland Scientists, South Atlantic Chapter (SWS)

Southeastern Fishes Council (SFC)

Southeastern Society of Parasitologists (SSP)

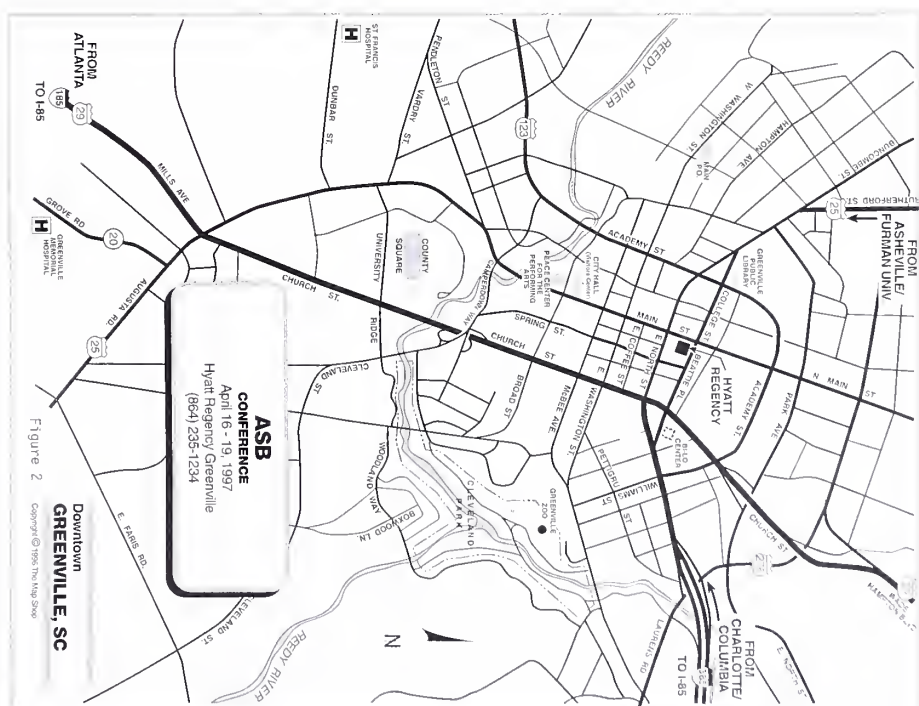
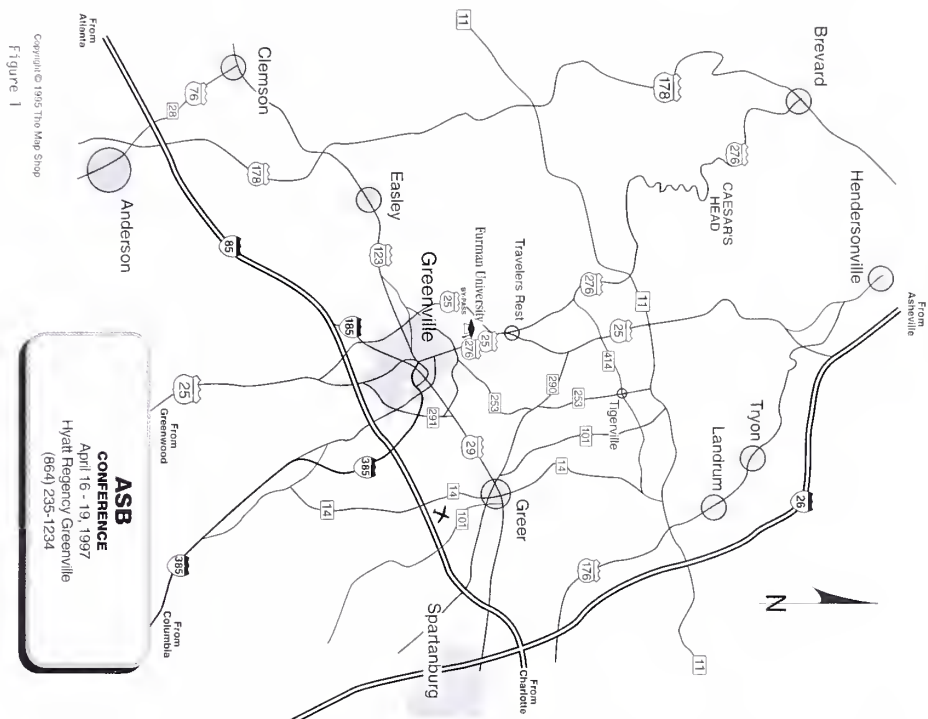
Southern Appalachian Botanical Society (SABS)



Furman University is an independent, coeducational, liberal arts college located on a 750-acre suburban campus on the outskirts of Greenville, South Carolina. The mountain view from the Furman Lake is a large draw for all who visit the campus.



The Hyatt Regency Greenville



GENERAL INFORMATION

Registration - Registration information and the pre-registration form were published in the January 1997 issue of the *ASB Bulletin*. Pre-registrants may pick up their registration packet at the ASB registration desk located in the lobby of the Hyatt Regency Greenville. The desk will be staffed from noon to 10:00p.m. Wednesday, April 16, from 8:00a.m. to 5:00p.m. Thursday, April 17, and from 8:00a.m. to noon on Friday, April 18. Conference participants are urged to take the April issue of the *ASB Bulletin* containing detailed program information to the conference. Copies will be for sale at the ASB registration desk. Detailed program information including the schedule of talks will also be available on the World Wide Web (www.furman.edu/~pollard/ASB/). For further information contact Dr. Lew Stratton, Department of Biology, Furman University, 3300 Poinsett Highway, Greenville SC 29613-0418 (864-294-3249; lew.stratton@furman.edu).

Ground Travel - Greenville is easily accessed from several major highways (figure 1). If you are traveling north on I-26 from Columbia, SC, take I-26 to the I-385 interchange. Take I-385 N to Greenville. I-385 N goes directly into downtown Greenville where it turns into a city street, Beattie Place. The Hyatt will be on your left at the intersection of Beattie Place and Main Street (figure 2).

If you are traveling North on I-85 from Atlanta, exit at I-185 N (the first Greenville exit). I-185 N turns into a city street, Mills Avenue (US 29), which shortly changes its name to Church Street. Church Street then enters downtown from the south. Turn left on Beattie Place. The Hyatt will be on your left at the intersection of Beattie Place and Main Street (figure 2).

If you are traveling south on I-85 from Charlotte, NC, take I-85 to the I-385 interchange. Take I-385 N, then follow the directions above.

If you are traveling south on I-26 E from Asheville, take the Greenville exit (exit 23 - US 25) just south of Hendersonville, NC. Take US 25 S, being sure to follow US 25 Business, not US 25 Bypass, at Travelers Rest, SC. When you approach downtown Greenville, take US 25 S straight onto North Street. Do not follow the signs telling you to turn right with US 25 S onto Academy Street. One block after Main Street turn left on Spring Street, then turn left on Beattie Place. The Hyatt is immediately on your left (figure 2).

Air Travel - Greenville-Spartanburg Airport is located about 15 miles from downtown Greenville. The Hyatt Regency Greenville will provide free shuttle service between the hotel and the Greenville-Spartanburg Airport for guests staying at the hotel. Arriving passengers can contact the Hyatt directly through courtesy phones at the airport. Those with alternative accommodations can make reservations for rental cars at the Greenville-Spartanburg Airport or can contact AAA Travel Agency (800-759-2621) to arrange shuttle service from the airport. From the airport, take I-385 north to Greenville, following directions above.

Parking - Parking will be available in a city parking garage located immediately before the Hyatt as you approach on Beattie Place. The Hyatt Regency has arranged special parking rates for ASB participants with the city of Greenville. To take advantage of these rates you must obtain a parking permit from the Hyatt Regency registration desk.

Job Placement and Message Boards - Job placement and message boards will be located near the ASB conference registration desk.

Dining Facilities - Meals are available in the Hyatt Regency. Restaurants within walking distance will be identified in the registration packet.

Social Activities and Events - Check your registration packet for tickets to the events for which you have pre-registered. Consult the program schedule for time and place of various events, meetings, and meals. A limited number of tickets may be available at the ASB registration desk for those who did not pre-register.

Wednesday Evening Social - A cash bar social will be held from 7:30-10:00p.m. in the Hyatt Atrium.

Thursday Mixer/Discussion: Minority Recruitment in Organismal Biology - What needs to happen to increase the number of minority students majoring in organismal biology (i.e., not health related or cellular/molecular biology)? Anyone interested in this vexing challenge is invited to join a discussion of obstacles and opportunities for minority recruitment. Participants in a new United Negro College Fund (UNCF)/Ecological Society of America (ESA) project whose goal is to increase the number of minority college students majoring in ecology will be part of the session. The mixer/discussion is sponsored by the Southeastern Chapter of the Ecological Society of America.

Thursday Evening Barbecue Buffet - The Thursday evening gathering will be held from 6:30-10:30p.m. at the Peace Center for the Performing Arts and will feature an "all you care to eat" barbecue/fish-fry buffet, beer and other refreshments, and live music. The Peace Center occupies a complex of restored historic textile mills, on the banks of the Reedy River, near the original site of downtown Greenville. The walk from the Hyatt is a pleasant stroll of less than 1/2 mile.

Friday Evening ASB Banquet - A cash bar social hour will be held from 6:00-7:30p.m. in the Hyatt Regency Pre-Function Area. The ASB Banquet will be held from 7:30-10:00p.m. in the Regency Ballroom of the Hyatt Regency and will feature a choice of entrees (fish, poultry, vegetarian).

Field Trips - All field trips depart from the front loading circle of the Hyatt Regency. Details regarding each trip appear in the January 1997 *ASB Bulletin*.

Local Arrangements Committee (area code 864)

Local Arrangements:	Lew Stratton	294-3249; lew.stratton@furman.edu
Program and Audiovisuals:	Joe Pollard	294-3244; pollard@furman.edu
Social Arrangements:	Irene Kokkala	294-3245; kokkala@furman.edu
Commercial Exhibits:	John Snyder	294-3248; john.snyder@furman.edu
Field Trips:	Wade Worthen	294-3390; worthen@furman.edu
Registration:	Laura Thompson	294-2085; laura.thompson@furman.edu
Meeting Statistics:	Bill Blaker	294-3084; blaker@furman.edu
Conference Organizer:	Helen Stratton	294-3083; helen.stratton@furman.edu

Useful Phone Numbers

AAA Travel Agency	800-759-2621
Hyatt Regency Reservations	800-233-1234
Hyatt Regency Greenville	(864) 235-1234
	fax: (864) 370-9204

ASB CANDIDATES FOR OFFICE - 1997

The nominating Committee, composed of Mike Baranski, Chair, Ed Clebsch, and Ken Marion, has selected the following slate of nominees for the ASB offices to be filled in 1997. Additional nominations will be received from the floor. Voting will take place at the Annual Business Meeting at 11:30 AM, Friday, 18 April, 1997. Please plan to attend.

President-Elect: **Eloise B. Carter**

Frank J. Schwartz

Vice President: **Howard S. Neufeld**

J. Dan Pittillo

Secretary: **Andrew N. Ash**

Zack E. Murrell

*Executive
Committee:* **Ross C. Clark**

George Cline

Patricia B. Cox

Terry D. Richardson

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Oxford, Georgia

UNC Institute of Marine Sciences
Morehead City, North Carolina

Appalachian State University
Boone, North Carolina

Western Carolina University
Cullowhee, North Carolina

Pembroke State University
Pembroke, North Carolina

Western Kentucky University
Bowling Green, Kentucky

Eastern Kentucky University
Richmond, Kentucky

Jacksonville State University
Jacksonville, Alabama

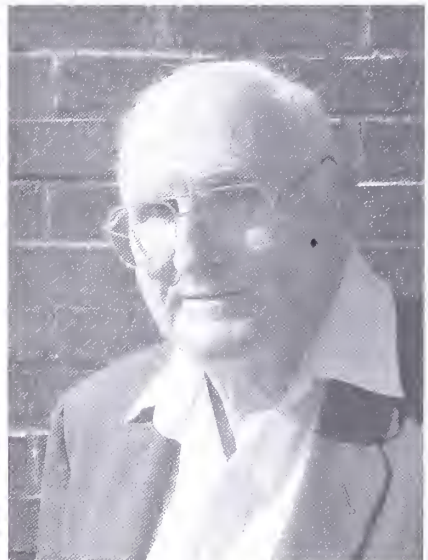
University of Tennessee
Knoxville, Tennessee

University of North Alabama
Florence, Alabama

PRESIDENT-ELECT

Eloise Carter

Frank Schwartz



Eloise B. Carter — Dr. Carter is Associate Professor of Biology and Chair of the Division of Natural Science and Mathematics at Oxford College of Emory University, Oxford, Georgia. She received her A.B. from Wesleyan College, Macon, GA, and the M.S. and Ph.D. in plant ecology and evolution from Emory University. Dr. Carter taught at Agnes Scott College, Decatur, GA and Emory College of Emory University before joining the faculty at Oxford in 1988. Her research interests include community ecology of Piedmont forests and the population biology of plant species endemic to southeastern granitic outcrops. Her publications include numerous journal articles and *Investigating Biology*, a laboratory manual for introductory biology. Dr. Carter has been an active member of ASB since 1977 and has served on the Executive Committee, the Research Awards Committee, and the Board of the ASB Enrichment Fund. She is presently Vice President of ASB. Dr. Carter is a member of the Botanical Society of America, the Ecological Society of America, the Southern Appalachian Botanical Society, the Association of Biology Laboratory Educators, and Sigma Xi. She has served as Secretary of the Southeastern Chapter of ESA and on various committees for the Southeastern Chapter of BSA. She is a member of the Scientific Advisory Boards for The Nature Conservancy and the Plant Collections Committee for the Atlanta Botanical Garden. In the last five years, she has worked with regional and national groups to improve pre-college science education through partnerships between ecologists and K-12 teachers. Dr. Carter participated in the ESA ecology in Education Workshops in the Southeast and the Rocky Mountains. She teaches in the Oxford Institute for Environmental Education, a summer program for pre-college teachers that emphasizes the use of schoolyards as outdoor classrooms, where students and teachers design and implement their own investigations. Dr. Carter received the 1987 ASB Research Award and the 1993 ASB Meritorious Teaching Award.

Frank J. Schwartz — Dr. Schwartz is Professor of Marine Sciences at the University of North Carolina's Institute of Marine Sciences, Morehead City, NC. He received his B.S. (1950), M.S. (1952), and Ph.D. (1954) in Zoology and Ichthyology at the University of Pittsburgh. He has held teaching and research positions at West Virginia University, Creighton University, and the University of Maryland's Chesapeake Biological Laboratory prior to joining the Institute in 1967, where he has taught Ichthyology and sampling methods. Dr. Schwartz is a member of 10 scientific societies and has traveled, given papers, and conducted research worldwide on grants from the Smithsonian Institution, the American Museum of Natural History, the National Science Foundation, the Office of Naval Research, and the National Academy of Sciences. His current researches involve marine and freshwater fishes, especially sharks; rare and endangered species; fish hybrids; and sea turtles. Over 300 published papers have resulted from these and other vertebrate and invertebrate studies. He has supervised grants, valued over \$3.4 million, and 5 Ph.D. and 19 M.S. students while at UNC. He has been editor of the *Transactions of the American Fisheries Society*, *Copeia*, and *Journal of the Elisha Mitchell Scientific Society* and co-editor of *Chesapeake Science* and *Ciencias Marinas*. As a longtime member of ASB, Dr. Schwartz has given numerous papers at the annual meetings and served ASB in various capacities as section chairman, member of the executive board, book review editor, and, for nine years, as editor of *The ASB Bulletin*.

VICE PRESIDENT

Howard S. Neufeld — Dr. Neufeld is an Associate Professor in the Department of Biology, Appalachian State University, Boone, North Carolina. He received his B.S. degree in Forestry from Cook College, Rutgers University in 1975, a M.F. degree in 1977 from the Yale School of Forestry and Environmental Science, and his Ph.D. in Botany from the University of Georgia in 1984. He was a postdoctoral research fellow in the Biology Department at New Mexico State University, where he worked on salinity tolerance of range grasses and adaptive aspects of light interception in creosote bushes. He held a National Research Council Postdoctorate at the U.S. EPA Lab in Corvallis, Oregon where he worked on the responses of various tree species to ozone exposure. He has been a member of ASB since 1982, serving on the Executive Committee from 1993-96. He has served as Chair of the Place of Meeting Committee, and he has served on the Patron Members and Exhibitors and Resolutions Committees. He was Program Chair for the 1991 ASB meeting in Boone. He received the ASB Research Award in 1992 for a paper on sugarcane water relations. He and his students have presented their work at ASB, having given over 30 presentations in the past 10 years. He is a member of the Ecological Society of America, Sigma Xi, Torrey Botanical Club, and WorldWatch. Since coming to ASU, he has done research on spruce-fir decline in cooperation with the TVA and was the director of the ozone exposure project in Great Smoky Mountains National Park, funded jointly by the NPS and EPA. He currently teaches Introductory Biology for non-majors, Plant Physiology, Organismal Ecology, and General Ecology, while maintaining an active research lab. He has traveled to Japan, China and Mexico, where he has presented papers at the INTECOL meetings, International Botanical Garden Society Meetings, and Air Pollution Workshop, respectively. He has served on the Faculty Senate at ASU, and he is an avid euphonium player in a local community band.

J. Dan Pittillo — Dr. Pittillo is Professor of Biology at Western Carolina University, Cullowhee, NC, the professorship he has occupied since matriculating in 1966. He received his A.B. degree at Berea College in 1961, M.S. in Botany at the University of Kentucky in 1963, and Ph.D. in Botany at the University of Georgia in 1966. At WCU, he also serves as Curator of the Herbarium and as consultant to several agencies: U. S. Forest Service; National Park Service; U. S. Fish and Wildlife Service; N. C. Natural Heritage Program, which he help establish in 1977; North Carolina Arboretum; N. C. Department of Tourism; Highlands Biological Station; The Nature Conservancy; The Wilderness Society; and the Western North Carolina Alliance. His interests botany and conservation have resulted in numerous publications and presentations in floristics; plant distributions; vicariads of the southern Appalachians and Yunnan, China; autecology; paleoecology; and plant management. He specializes in vegetation of the southern Appalachians and has served as newsletter editor for the past four years for the Southern Appalachian Botanical Society. He also has served as the President of Highlands Biological Foundation since 1992. He is a member of the Ecological Society of America, N. C. Academy of Science, Sigma Xi Research Honorary, and the Association of Southeastern Biologists. A member of ASB since 1964, he has served on the Place of Meeting Committee, chaired the Public Affairs Committee, served as symposium leader for two years, and served several years as paper session chair. Along with Hazel Delcourt, he was recipient of the ASB Research Award in 1985. He was a recipient of the Esther C. Cunningham Award for his work in conservation in 1982, the Paul A. Reid Distinguished Service Award in 1992, and the North Carolina Governors Award of Excellence in 1992.

SECRETARY

Andrew N. Ash — Dr. Ash is Professor of Biology at Pembroke State University, Pembroke, North Carolina. He received an undergraduate degree in biology from the Virginia Military Institute, a M.S. in plant ecology from North Carolina State University, and a Ph.D. in wildlife biology from the University of Toronto. His research has focused on the effects of clearcutting on Southern Appalachian salamanders. He is a member of the Ecological Society of America, ASB, the Southern Appalachian Botanical Society, and other organizations. Dr. Ash is Secretary/Treasurer of the Southeastern Section of ESA. He currently serves on the following committees: N.C. Nongame Wildlife Advisory Committee, N.C. State Parks Natural Heritage Advisory Committee, ASB Patrons and Exhibitors Committee, SABS Membership Committee, SABS Bartholomew Award Committee (chair), ESA Odum Award Committee (past chair), Highlands Biological Station Board of Scientific Advisors, Highlands Biological Station Board of Trustees. He is a past member and chair of the ASB Education Committee.

Zack E. Murrell — Dr. Zack Murrell is an assistant professor and curator of the herbarium at Western Kentucky University in Bowling Green. He received his B.S. from Davidson College (1980), M.S. from the University of Tennessee-Knoxville (1985), and Ph.D. from Duke University (1992). Prior to his current position, he was a National Science Foundation post-doctoral fellow at the University of Arizona and Harvard University and an Arnold Arboretum Fellow at the Arnold Arboretum and Harvard University. He currently serves on the Council of the Southern Appalachian Botanical Society and is the Kentucky representative on the SABS Membership Committee. His research interests involve the study of evolutionary relationships, especially those of plants exhibiting a Laurasian distribution pattern, using morphological, micromorphological (SEM), and molecular (ITS of nuclear rDNA) evidence. The focus of his research has been on species and subgeneric relationships in *Cornus*, species relationships in *Asarum* and *Spiraea*, and the flora and phytogeographical relationships of south-central Kentucky. He is a member of ASB, the Botanical Society of America, the American Society of Plant Taxonomists, the Southern Appalachian Botanical Society, Sigma Xi, the Society of Systematic Biologists, and the Society for Molecular Biology and Evolution.

EXECUTIVE COMMITTEE

Ross C. Clark — Dr. Clark is Professor of Biology and Chair for the Department of Biological Sciences at Eastern Kentucky University. He earned his B.A. in biology from the University of the South in Sewanee, Tennessee. He completed his master's and Ph.D. work in plant systematics and ecology at the University of North Carolina at Chapel Hill, where he was a student of Dr. Albert E. Radford. Prior to assuming his current position, he taught for five years at the University of South Carolina at Spartanburg, six years at Erskine College, and served 12 years as Curator of Education at the Morton Arboretum, where he founded the Arboretum's interinstitutional college botany program. His present teaching duties include nonmajors courses in biology and ecology, general botany, and advanced courses in plant systematics and ecology. Dr. Clark's main research interests are in the systematics, distribution and ecology of Temperate Zone woody plants, especially the hollies (Aquifoliaceae).

George Cline — Dr. Cline is an Assistant Professor of Biology at Jacksonville State University in Alabama. He earned his B.S. at Indiana University of Pennsylvania in Biology and Environmental Health and his Ph.D. in Zoology at Oklahoma State University. His research interests are in frog communication systems, biology and conservation of amphibians and reptiles, and application of satellite technologies to environmental assessment. George has received funding from several sources including NASA EPSCoR, USFWS, DOD, NRCS, Hawk Mountain Sanctuary Association, and the JSU Faculty Research Committee. He is the Remote Sensing Co-Cluster leader for the Alabama Space Grant EPSCoR grant. He has served on the ASB Graduate Student Support Award Committee (current chair), the SEASIH Secretary (current), and he is active in the Alabama Herpetological Society. George is active in undergraduate student research and serves as the chairman of the JSU Student Research Symposium Committee. His students have given talks at ASB, the Alabama Academy of Science, the Alabama Herpetological Society, and the Society for the Study of Amphibians and Reptiles. In addition, George is active in community education programs, such as the Little River Canyon Field School, and as cosponsor of the HerpFest series with the Anniston Museum of Natural History.

Patricia B. Cox — Dr. Cox is the Teaching Laboratory Coordinator for the Division of Biology at the University of Tennessee, Knoxville. Previously, she was an Instructor for the General Biology Program and a Research Associate in the Department of Botany. She earned her B.S. (1976) and M.S. (1978) in Biology from Northeast Louisiana University and her Ph.D. (1991) in Botany from Louisiana State University. Her research interests are in the systematics of *Rudbeckia* and related composites, and she is contributing the treatment of the "coneflower" genera for the Flora of North America project. She was the 1995 recipient of the Richard and Minnie Windler Award for the best published paper in *Castanea*. Patricia has been an active member in a number of societies. She was the American Society of Plant Taxonomists Local Representative for the 1994 AIBS meetings held in Knoxville and served as Co-Program Chairman for the 1995 ASB meetings, also hosted by the University of Tennessee. Currently, Dr. Cox serves the Southern Appalachian Botanical Society as Representative to the Great Smoky Mountain Wildflower Pilgrimage and is completing a two-year term as member-at-large on the SABS Council.

Terry D. Richardson — Dr. Richardson is an Assistant Professor in the Department of Biology at the University of North Alabama, Florence. He earned a B.S. in Professional Biology from the University of North Alabama, a M.S. in Aquatic Biology from the University of Alabama, and a Ph.D. in Zoology and Physiology from Louisiana State University. In 1990 he received an Oak Ridge Associated Universities Postdoctoral Fellowship, and he accepted his current position at the University of North Alabama in 1991. Dr. Richardson presently teaches nonmajors biology and upper division courses in Aquatic Ecology, General Ecology, and Vertebrate Physiology. He also teaches a summer course in Marine Behavioral Ecology at the Dauphin Island Sea Laboratory, Dauphin Island, Alabama. He is currently director of the Center for Rare and/or Endangered Species Research and conducts surveys and research related to rare and endangered bivalves and snails. His research interests include population and production ecology of marine and freshwater mollusks and wetland invertebrates and environmental influences on the behavior of marine invertebrates. He is a member of the Ecological Society of America, the North American Benthological Society, and Tri-Beta. He has served two years on the ASB Student Research Awards Committee and is currently chair of that committee.

PLENARY SPEAKER



Nat B. Frazer, Ph.D.

Savannah River Ecology Laboratory

“National Environmental Research Parks: The Cold War’s Positive Legacy”

Dr. Nat B. Frazer grew up running around barefoot in the woods of south Georgia. He received a Bachelor's degree in History from the University of Georgia and a Master's degree in History and Public Affairs from Sangamon State University (now the University of Illinois at Springfield). He served as a legislative intern in the Georgia House of Representatives during Jimmy Carter's Gubernatorial Administration. After completing his Ph.D. at the University of Georgia's Institute of Ecology, where he studied the life history and demography of sea turtles, Dr. Frazer held a Fellowship in Marine Policy and Ocean Management at the Woods Hole Oceanographic Institution. During that time, he helped to set up an international conservation network throughout the Caribbean basin and Central America. Dr. Frazer joined the faculty of Mercer University in 1985, where he later served as Chairman of the Biology Department. He has authored over 40 scientific papers on population biology and conservation, and serves on several national and international conservation committees. He currently holds adjunct graduate faculty appointments at both Mercer University and at the University of Georgia. In 1993, he was selected as a participant in the Leadership Georgia program. He is presently Associate Director for Research at the Savannah River Ecology Laboratory and also serves as Director of the U.S. Department of Energy's Savannah River National Environmental Research Park.

PROGRAM SUMMARY

All events will be held at the Hyatt Regency Greenville unless otherwise noted. See floor plan in this issue of the *Bulletin*.

Wednesday, April 16, 1997

- 9:00a.m.-3:00p.m. **Field trip** departs from the front loading circle of the Hyatt Regency. See January 1997 issue of the *ASB Bulletin* for details.
- 12:00p.m.-10:00p.m. **Registration**, *Hyatt Atrium*
- 3:00p.m.-7:00p.m. **ASB Executive Committee Meeting**, *Dogwood Suite*
- 4:00p.m.-7:00p.m. **SABS Council Meeting**, *Gardenia Suite*
- 4:00p.m.-5:00p.m. **SE Society of Parasitologists Council Meeting**, *Magnolia Suite*
- 5:00p.m.-7:00p.m. **Presidential Symposium, SE Society of Parasitologists: Perspectives on Complex Host-Parasite Interrelationships**, *Redbud Suite*
- 7:30p.m.-10:00p.m. **ASB Social Hour** with cash bar, *Hyatt Atrium*
- 8:00p.m.-10:00p.m. Continuation of **ASB Executive Committee Meeting** (if needed), *Dogwood Suite*

Thursday, April 17, 1997

- 7:00a.m.-8:30a.m. Light breakfast buffet (cash), *Hyatt Atrium*
- 7:00a.m.-8:00a.m. Past Presidents' Breakfast, *Gardenia Suite*
- 7:00a.m.-8:30a.m. Poster set-up, *Crepe Myrtle*
- 8:00a.m.-5:00p.m. **Registration**, *Hyatt Atrium*
- 8:00a.m.-5:00p.m. Slide preview, *Azalea A and B*
- 8:30a.m.-10:00a.m. **Plenary Session**, *Regency A,B,C*
- 10:00a.m.-5:00p.m. **Commercial Exhibits**, *Continental Ballroom*
- 10:00a.m.-5:00p.m. **Poster Session** (Presenters with posters 3:00-4:00), *Crepe Myrtle*

Morning Paper Sessions

- 10:00a.m.-12:00p.m. Plant Ecology, *Redbud Suite*
- 10:00a.m.-12:00p.m. Ichthyology, *Regency D*
- 10:00a.m.-12:00p.m. Aquatic and Wetland Ecology, *Regency E*
- 10:00a.m.-12:00p.m. Parasitology, *Regency F*
- 10:00a.m.-12:00p.m. Plant Systematics, *Dogwood Suite*
- 10:00a.m.-12:00p.m. Cellular and Molecular Biology, *Magnolia Suite*

Luncheon Meeting

- 12:00p.m.-1:30p.m. **Society of Wetland Scientists**, *Teal Suite*

Afternoon Paper Sessions

- 1:00p.m.-5:15p.m. **ESA Symposium: Vegetation of the Southern Blue Ridge Province**, *Regency A*
- 1:30p.m.-5:15p.m. Animal Ecology, *Redbud Suite*
- 1:30p.m.-5:15p.m. Invertebrate Zoology, *Regency E*
- 1:30p.m.-4:15p.m. Evolution, *Regency D*
- 1:30p.m.-4:30p.m. Parasitology, *Regency B,C*
- 1:30p.m.-4:00p.m. Cryptogamic Botany, *Dogwood Suite*
- 1:30p.m.-4:45p.m. Plant Ecology, *Regency F*

Business Meetings

- 4:00p.m.-5:00p.m. **Herbarium Curators Meeting**, *Dogwood Suite*
 4:00p.m.-5:00p.m. **American Society of Ichthyologists and Herpetologists**,
Magnolia Suite
 5:00p.m.-6:00p.m. **Southeastern Fishes Council**, *Magnolia Suite*

Special Events

- 1:00p.m.-5:30p.m. **Beta Beta Beta Field Trip** (departs from the front loading circle
 of the Hyatt Regency)
 4:30p.m.-5:30p.m. **Mixer/Discussion on Minority Recruitment in Organismal
 Biology**, *Gardenia Suite*
 6:30p.m.-10:30p.m. **ASB Barbecue/Fish-fry Social**, *Peace Center for the
 Performing Arts* (corner of Main and Broad Streets, 0.4 mi. south
 of the Hyatt)

Friday, April 18, 1997

- 7:00a.m.-8:30a.m. **Breakfast and Business Meeting**, Southern Appalachian
 Botanical Society and SE Section, Botanical Society of America,
Teal Garden
 7:00a.m.-8:30a.m. Light breakfast buffet (cash), *Hyatt Atrium*
 8:00a.m.-5:00p.m. Slide preview, *Azalea A and B*
 8:00a.m.-5:00p.m. **Poster Session** (Presenters with posters 3:00-4:00), *Crepe Myrtle*
 10:00a.m.-5:00p.m. **Commercial Exhibits**, *Continental Ballroom*
 8:00a.m.-5:00p.m. Beta Beta Beta book display, *Boardroom*

Morning Paper Sessions

- 8:00a.m.-11:15a.m. Plant Ecology I, *Regency A*
 8:45a.m.-11:30a.m. Plant Ecology II, *Regency B,C*
 8:00a.m.-10:15a.m. Parasitology, *Regency D*
 8:00a.m.-11:30a.m. Herpetology, *Regency E*
 8:00a.m.-11:30a.m. Aquatic and Wetland Ecology, *Regency F*
 8:00a.m.-11:00a.m. Beta Beta Beta, *Redbud Suite*
 8:00a.m.-11:00a.m. **BSA Workshop**: Application of Recent Technological Advances
 to Plant Mating Studies, *Magnolia Suite*

Business and Luncheon Meetings

- 11:00a.m.-12:00p.m. **Beta Beta Beta Business Meeting**, *Redbud Suite*
 12:00p.m.-1:30p.m. **Beta Beta Beta Luncheon**, *Fuddrucker's Restaurant*, 221 N.
 Main Street
 11:30a.m.-12:30p.m. **ASB Business Meeting and Election of Officers**, *Regency A*
 12:30p.m.-2:00p.m. **Ecological Society of America, SE Chapter**, Luncheon and
 Business Meeting, *Teal Garden*

Afternoon Paper Sessions

- 1:30p.m.-4:30p.m. Beta Beta Beta, *Redbud Suite*
 1:30p.m.-4:30p.m. Beta Beta Beta, *Magnolia Suite*
 1:30p.m.-4:30p.m. Beta Beta Beta, *Dogwood Suite*
 1:30p.m.-3:15p.m. Teaching Biology, *Gardenia Suite*
 1:30p.m.-5:00p.m. Ichthyology, *Regency E*

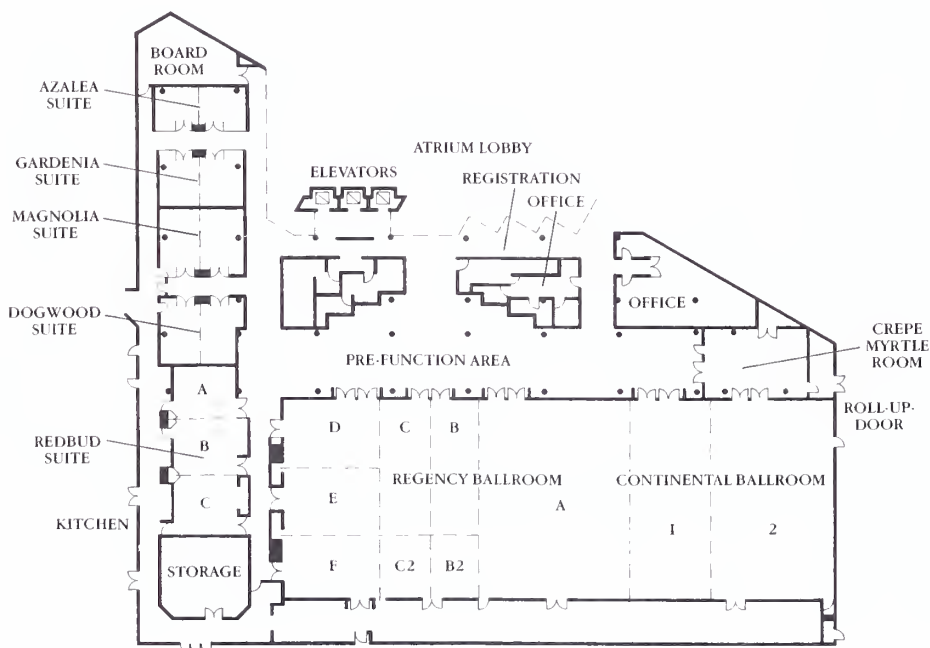
- 2:00p.m.-4:30p.m. Plant Systematics, *Regency D*
 2:00p.m.-5:00p.m. Plant Ecology, *Regency F*
 2:30p.m.-4:30p.m. **Symposium:** The Importance of Cliff-Face Communities in Plant Ecology, *Regency B,C*
 3:10p.m.-5:00p.m. **ASB Teaching Workshop:** Active Learning and Projected Computer Presentation Packages in Large Lecture Biology Classes, *Gardenia Suite*

Special Events

- 6:00p.m.-7:30p.m. **ASB Social Hour** (cash bar), *Hyatt Pre-Function Area*
 7:30p.m.-10:00p.m. **ASB Banquet**, *Regency Ballroom*

Saturday, April 19, 1997

- 7:00a.m.-9:00a.m. **ASB Executive Committee Breakfast Meeting**, *Teal Garden*
 8:00a.m.-10:00a.m. **Field Trips** depart from the front loading circle of the Hyatt Regency. See January 1997 issue of the *ASB Bulletin* for details.



Floor plan of the Hyatt Regency meeting facilities

ASB PAPER AND POSTER SESSIONS

Wednesday Evening, April 16, 1997

PRESIDENTIAL SYMPOSIUM - *Redbud Suite*

Perspectives on Complex Host-Parasite Interrelationships

Sponsored by the SE Society of Parasitologists

- 5:00 1 **Tarleton, R.D.** (University of Georgia) Chagas' disease: autoimmune or parasite inflammatory disease?
- 5:40 2 **O'Brien, Jack J.** (University of South Alabama) What's so special about parasitic castration?
- 6:20 3 **Caira, J.N.** (University of Connecticut) Evolution and site specificity in the tapeworms parasitizing elasmobranchs.

Thursday Morning, April 17, 1997

PLENARY SESSION - *Regency A,B,C*

8:30 **David E. Shi.** President, Furman University. Welcoming remarks.

James S. Fralish, ASB President. Response.

Nat B. Frazer, Savannah River Ecology Laboratory. Invited plenary speaker.

POSTERS - *Crepe Myrtle*

April 17-18

Posters displayed 10:00a.m.-5:00p.m.

Presenters with posters 3:00-4:00p.m.

- 4 **Lickey, Adrienne and William E. Dobson.** (Appalachian State University) Effects of environmental factors on ossicle banding patterns in *Amphiopholis gracillima*.
- 5 **Harrell, Michael T. and Anna M. Hill.** (Northeast Louisiana University) Will vitamin enriched diets enhance growth of hatchling alligator snapping turtles (*Macroclemys temminckii*)?
- 6 **White, Peggy L. and M. Catharine Cox.** (Wingate University) The effects of estradiol-17 β on the development of the clitero-penis in the American alligator, *Alligator mississippiensis*.
- 7 **Wise, Dwayne, Holly Kupfer, and Natale Tatc.** (Mississippi State University) The ultrastructure of sex chromosome association during meiosis in spider spermatocytes.
- 8 **Camlin, Amanda and G.R. Davis.** (Wofford College) Developmental changes in myelin in the spinal cord of the bullfrog (*Rana catesbeiana*).
- 9 **McCallum, Jeffrey B. and Edmund J. Stellwag.** (East Carolina University) DNA sequence analysis of a putative HoxB2 containing genomic clone from the teleost, *Morone saxatilis*.

- 10 **Moser, Mary L., Fred C. Rohde, and Rudolf G. Arndt.** (University of North Carolina-Wilmington Center for Marine Science Research, North Carolina Division of Marine Fisheries, and the Richard Stockton College of New Jersey) Distribution of the brook silverside, *Labidesthes sicculus*, in North Carolina.
- 11 **Bennett, Chipley B. and Thomas McInnis.** (Clemson University) Assessment of drought tolerance in endophyte-infected tall fescue.
- 12 **Goleman, Wanda, Kim Marie Tolson, and Janis Gulick.** (Northeast Louisiana University) Characterization of hematopoietic cells in the bone marrow of the nine-banded armadillo.
- 13 **Adams, Harold S., Steven L. Stephenson, and Stewart A. Ware.** (Dabney S. Lancaster Community College, Fairmont State College, and College of William and Mary) Mid-Atlantic forests with a beech component.
- 14 **Dimock, Ronald V., Jr. and Randall W. Strube.** (Wake Forest University) Unionid mussels release glochidia larvae in response to exogenous serotonin.
- 15 **Marks, Susan.** (Winthrop University) Effects of nutrient availability on competitive ability of tall fescue infected with a fungal endophyte.
- 16 **Shew, H. Wayne.** (Birmingham-Southern College) Cytogenetics of *Cakile*: preliminary observations.
- 17 **Morton, Wade and Edward Mills.** (Wingate University) Niche overlap and resource partitioning among five turtle species in Lake Wingate, NC.
- 18 **Barnwell, Michael K., Gary Durrant, Kenneth Pilgreen, and George Cline.** (Jacksonville State University) Anatomical description of "Henson's cartilage" located between the vomer, maxilla, and premaxilla in the skull of bottlenose dolphins, *Tursiops truncatus*.
- 19 **Kahn, Wendy and R.G. Wetzel.** (University of Alabama) Effects of UV irradiance and microscale water level fluctuations on periphytic microbiota.
- 20 **Alkaff, Huda F.** (University of Georgia) Sea-level rise and coastal wetlands: The Sapelo Island Complex, GA.
- 21 **Cooper, Aaron and G.R. Davis.** (Wofford College) Localized injection of neurotransmitters into the brainstem evokes locomotor activity in the isolated central nervous system of bullfrog larvae (*Rana catesbeiana*).

- 22 **Jones, M. Tildon, Robert M. Jetton, and Wade B. Worthen.** (Furman University) Desiccation stress contributes to the nested subset structure of mycophagous fly communities.
- 23 **Sepulveda, Shannon R. and Stephen B. White.** (Murray State University) The wildlife diversity funding initiative: a potential new source of funding for research.
- 24 **DiMasi, M. Katie, Linda E. Watson, and Timothy M. Evans.** (Miami University of Ohio) Molecular phylogeny of tribe Anthemideae, based on sequences of the internal transcribed spacers of nuclear ribosomal DNA.
- 25 **Mayo, Dobb.** (University of North Carolina-Wilmington Center for Marine Science Research) Eutrophication and its consequences on fish assemblages.
- 26 **Dandridge, Keri L. and A. Joseph Pollard.** (Furman University) Variation in zinc and nickel hyperaccumulation by *Thlaspi caerulescens* from different soil types.
- 27 **Bennetsen, Derek and Linda E. Watson.** (Miami University of Ohio) Genetic variation in the invasive species *Lonicera mackii*.
- 28 **Schmidt, John M.** (Winthrop University) Sex and smut in a clonal sedge (*Carex picta* Stued.).
- 29 **Sewalk, Chester, Gwenda L. Brewer, and David Hoffman.** (Frostburg State University, Patuxent Wildlife Research Center) Effects of diquat on development in mallard embryos.
- 30 **Christy, Arthur M., Jr. and A. Joseph Pollard.** (Furman University) Metal tolerance and accumulation in *Plantago lanceolata*.
- 31 **Weishampel, John F., David J. Harding, Jason B. Drake, and Jeffry C. Boutet.** (University of Central Florida, and NASA Goddard Space Flight Center) Analysis of laser altimeter waveforms for forested ecosystems of central Florida.
- 32 **Woodhead, Jennifer L. and Daniel B. Plyler.** (University of North Carolina at Wilmington) *In vitro* propagation of threatened *Amaranthus pumilus*.
- 33 **Gamble, Robert J. and David G. Lindquist.** (University of North Carolina at Wilmington) Using infrared satellite imagery to predict Gulf Stream intrusions into Onslow Bay, NC that may be transporting larval fish.

- 34 **Wohl, Debra L. and J. Vaun McArthur.** (University of Georgia, Savannah River Ecology Laboratory) Bacterial-fungal antagonism and the indirect effect on organic matter decomposition in lotic environments.
- 35 **Burse, Jeanine R. and Henry L. Bart, Jr.** (Tulane University) Spawning frequency of the scaly sand darter, *Ammocrypta vivax*.
- 36 **Renne, Ian J.** (Clemson University) Use and dispersal of the Chinese tallow tree *Sapium sebiferum* by birds in coastal South Carolina.
- 37 **Cook, Susan B. and Debra K Krumm.** (Harbor Branch Oceanographic Institution) Combining 'hands on' with 'high tech': using video and CD-ROM resources in effective field courses.

PLANT ECOLOGY - *Redbud Suite*

Presiding: *Frank P. Day*, Old Dominion University

- 10:00 38 **Conner, William H.** (Baruch Forest Science Institute) Comparison of primary productivity of eight forested wetlands in South Carolina.
- 10:15 39 **Spratt, Henry G., Jr., Melissa R. Eslinger, and Jennifer M. Pulliam.** (University of Tennessee, Chattanooga) Pretreatment carbon and sulfur transformations in A-horizon soils of the Missouri Ozark Forest ecosystem project.
- 10:30 40 **Martin, William A. and Frank S. Gilliam.** (Marshall University) Response of soil metal cations to nitrogen deposition in a Central Appalachian hardwood forest.
- 10:45 41 **Dilustro, John J. and Frank P. Day.** (Old Dominion University) The initial response of fine roots to elevated atmospheric carbon dioxide in an oak-palmetto scrub ecosystem.
- 11:00 42 **Collins, Christi and Raymond L. Petersen.** (Howard University) The effects of ozone deposition on the cinnamon fern *Osmunda cinnamomea* L. in the Monongahela National Forest, West Virginia.
- 11:15 43 **Robertson, Jennifer L. and Howard S. Neufeld.** (Appalachian State University) Ecophysiological significance of carbon gain by phyllodia and pitchers in carnivorous pitcher plants.
- 11:30 44 **Williams, Denise and Howard S. Neufeld.** (Appalachian State University) Factors affecting the spread of the introduced species, *Microstegium vimineum*, a shade tolerant, C₄ grass.
- 11:45 45 **Liu, Hong and Timothy P. Spira.** (Clemson University) Influence of seed age on seed germination, seedling vigor, and inbreeding depression in *Hibiscus moscheutos*.

ICHTHYOLOGY - *Regency D*

Presiding: *Byron J. Freeman*, University of Georgia

- 10:00 46 **Maurakis, Eugene G. and Diana L. Lipscomb.** (Science Museum of Virginia and George Washington University) Historical relationships of Atlantic slope river drainages.
- 10:15 47 **Johnston, C.E., J.R. Shute, P.L. Rakes, and P.W. Shute.** (USDA Forest Service, Conservation Fisheries, Inc., and Tennessee Valley Authority) Long-term monitoring of rare fishes in the Conasauga River, Tennessee and Georgia.
- 10:30 48 **Menhinick, Edward F.** (University of North Carolina at Charlotte) Heavy metal uptake by clams and fishes.
- 10:45 49 **Onorato, Dave, Robert A. Angus, Melinda M. Lalor, and Ken R. Marion.** (University of Alabama at Birmingham) Potential changes in the composition of ichthyofaunal assemblages in the upper Cahaba River as a result of urbanization.
- 11:00 50 **Devivo, Joseph C., Carol A. Couch, and Byron J. Freeman.** (Institute of Ecology and US Geological Survey National Water Quality Assessment Program) Preliminary use of an index of biotic integrity in urban streams around Atlanta, Georgia.
- 11:15 51 **Mayo, Dobb, Linda Lombardi, Troy Alphin, and Martin Posey.** (University of North Carolina at Wilimington and Center for Marine Science Research) Recovery of a fish community from a catastrophic event.
- 11:30 52 **M^cReynolds, William M., Michael L. Little, and Donald C. Tarter.** (Marshall University) Observations on isozyme patterns and meristics in mosquito fish (Pisces: Poeciliidae) from West Virginia, Kentucky, and Virginia.
- 11:45 53 **Strange, Rex Meade and Brooks M. Burr.** (Southern Illinois University at Carbondale and University of Alabama) Genetic variability and metapopulation dynamics in the threatened Blackside Dace, *Phoxinus cumberlandensis* (Pisces: Cyprinidae).

AQUATIC AND WETLAND ECOLOGY - *Regency E*

Presiding: *Donald C. Tarter*, Marshall University

- 10:00 54 **Francko, D.A., R.S. Whyte, H. Vance, and K. Degroft.** (Miami University) Biotic and abiotic factors affecting patch dynamics in wetland communities dominated by *Nelumbo lutea* (American lotus).

- 10:15 55 **Hall Rutherford, Rebecca and Thomas Weak.** (Marshall University)
The effects of water quality on periphyton communities of the New River
Gorge National River, West Virginia.
- 10:30 56 **Greene, Stephen D. and Donald C. Tarter.** (Marshall University)
Simultaneous chemical and benthic diversity comparisons of acid mine
drainage and unmitigated lotic systems.
- 10:45 57 **Henry, Andrea L. and Donald C. Tarter.** (Marshall University)
Ecological observations of *Crangonyx pseudogracilis* Bousfield
(Crustacea: Amphipoda) from the Green Bottom Wildlife Management
Area, Cabell County, West Virginia.
- 11:00 58 **Aderman, Jennifer A. and Donald C. Tarter.** (Marshall University)
Acid tolerance, under static bioassay conditions, of the freshwater prawn
Palaemonetes kadiakensis Rathbun from the Green Bottom Mitigation
Site, Cabell County, West Virginia.
- 11:15 59 **Gray, Margarit.** (Erskine College and Clemson University) Calcium
release from *Corbicula fluminea* shells in oligotrophic lakes.
- 11:30 60 **McFadden-Wenig, Colleen and Henry G. Spratt, Jr.** (University of
Tennessee at Knoxville and University of Tennessee at Chattanooga) The
effect of backflushing sand filtration systems on bacterial nitrification in
freshwater and saltwater aquaria at the Tennessee Aquarium.
- 11:45 61 **Beard, Charles E. and Peter H. Adler.** (Clemson University)
Distribution of trichomycete fungi in black flies.

PARASITOLOGY - Regency F

Presiding: *Gayle P. Noblet and David J. Soucek*, Clemson University

- 10:00 62 **Wikle, R.E., X.C. Moore, and J.C. Jarecki-Black.** (Rhone Merieux,
Inc.) Canine lyme disease (LD): efficacy and lack of interference of an
OspA combination vaccine.
- 10:15 63 **Prentice, Erik and Cheryl D. Davis.** (Western Kentucky University)
Enhanced resistance to *Trypanosoma cruzi* at elevated environmental
temperature: successful adoptive transfer to naïve mice.
- 10:30 64 **Hou, Yue and Cheryl D. Davis.** (Western Kentucky University)
Beneficial effect of vitamin E and selenium during experimental Chagas'
disease.
- 10:45 65 **Bogitsh, B.J., R. Ribeiro-Rodrigues, M.R. Stenger, and C.E. Carter.**
(Vanderbilt University) *In vitro* effects of the antitubulin trifluralin on
Trypanosoma cruzi epimastigotes.

- 11:00 66 **Wilhelm, E., J.E. Joy, and C.C. Slemp.** (Marshall University and West Virginia Division of Surveillance and Disease Control) Distribution of *Aedes triseriatus*, the mosquito vector of LaCross encephalitis, in West Virginia.
- 11:15 67 **Patton, Sharon, J.J. Zimmerman, Tanya Roberts, C.T. Faulkner, V.R. Diderich, A.M. Assadi-Rad, P.R. Davies, and J.B. Kliebenstein.** (University of Tennessee, Iowa State University, Economic Research Service, and North Carolina State University) Epidemiology of *Toxoplasma gondii* in hogs in the United States.
- 11:30 68 **Cheadle, Mark A., David S. Lindsay, Sara E. Rowe, and Byron L. Blagburn.** (Auburn University) Prevalence of antibodies to *Neospora caninum* and *Toxoplasma gondii* in horses from Alabama.
- 11:45 69 **Lindsay, D.S. and B.L. Blagburn.** (Auburn University) Prevalence of *Toxoplasma gondii* and *Sarcocystis spp.* In white-tailed deer and other animals from Alabama.

PLANT SYSTEMATICS - *Dogwood Suite*

Presiding: *Zack E. Murrell*, Western Kentucky University

- 10:00 70 **Anderson, Loran C.** (Florida State University) Unique stomatal patterns among *Sideroxylon* taxa of the United States.
- 10:15 71 **Johnson, Shelley L. and Kathleen A. Kron.** (Wake Forest University) Hybridization of *Rhododendron* cultivars and natural species: a molecular study.
- 10:30 72 **Watson, Linda E. and Timothy M. Evans.** (Miami University of Ohio) Molecular systematics of Tribe Anthemideae, based on chloroplast gene *ndhF*.
- 10:45 73 **He, Tao and Zack E. Murrell.** (Western Kentucky University) Micromorphological studies of two problematic species of dogwoods (Cornus: Cornaceae).
- 11:00 74 **Werth, Charles R., Linghe Zeng, and W. Vance Baird.** (Texas Tech University and Clemson University) An enigmatic tetraploid *Eleusine* (Gramineae) discovered in South Carolina.
- 11:15 75 **Nelson, John B.** (University of South Carolina) A problematic hedge-nettle (*Stachys*) from the coast of South Carolina.
- 11:30 76 **Haynes, Robert R. and C. Barre Hellquist.** (University of Alabama and North Adams State College) Alismatidae of North America.
- 11:45 77 **Gunn, Bob.** (The Drifting Seed, Brevard, NC) The coco-de-mer, *Lodoicea maldivica* (Gmelin) Persoon (Arecaceae): a unique drift endocarp that became a legend.

CELLULAR AND MOLECULAR BIOLOGY - *Magnolia Snite*

Presiding: *James B. Claiborne*, Georgia Southern University

- 10:00 78 **Stratton, Lewis P., Mike Kelly, Mark C. Manning, and John F. Carpenter.** (Furman University and University of Colorado Health Sciences Center) Behavior of proteins in temperature sensitive gels.
- 10:15 79 **Pivorun, Edward B.** (Clemson University) Diadenosine tetraphosphate modulates dopamine metabolism via a P₂ receptor in PC12 cells.
- 10:30 80 **Blackston, Christie R. and James B. Claiborne.** (Georgia Southern University and Mount Desert Island Biological Laboratory) Messenger RNA transcripts for isoforms of the Na⁺/H⁺ antiporter (NHE) in the gills of a marine fish, the long-horned sculpin, *Myoxocephalus octodecimspinosus*.
- 10:45 81 **Collins, Kristy R. and George J. Armelagos.** (Berry College and Emory University) The prevalence of tetracycline labeling in a Sudanese Nubian population (350-550 A.D.)
- 11:00 82 **Spratt, Henry G., Jr. and James T. Newby, Jr.** (University of Tennessee, Chattanooga) Isolation and characterization of soil bacterial cultures capable of growth on waste crankcase oil as a sole carbon source.
- 11:15 83 **Coggin, Steven J.** (Catawba College) The role of nutrient limitation and cell division pattern in yeast dimorphism.
- 11:30 84 **Barnett, Jason, Jagan V. Valluri, and H. Wayne Elmore.** (Marshall University) Protein synthesis and ethylene biosynthesis in sandalwood callus cultures exposed to drought and heat shock.
- 11:45 85 **Shull, J. Kenneth.** (Appalachian State University) Chromosome pairing in the interspecific hybrid *Lilium* X 'Black Beauty'.

Thursday Afternoon, April 17, 1997

SYMPOSIUM - *Regency A*

Vegetation of the Southern Blue Ridge Province

Sponsored by the Ecological Society of America, Southeastern Chapter

Presiding: *J. Dan Pittillo*, Western Carolina University and *Thomas R. Wentworth*, North Carolina State University

- 1:00 86 **Pittillo, J. Dan, Sanley W. Buol, and Robert D. Hatcher.** (Western Carolina University, North Carolina State University, The University of Tennessee, Knoxville, and Oak Ridge National Laboratory) Introduction to the vegetation and environment of the Southern Blue Ridge Province.

- 1:15 87 **Meier, Albert J. and Susan P. Bratton.** (University of Missouri-Columbia and Whitworth College) Environmental factors associated with occurrence of vernal herbs in the southern Appalachians.
- 1:30 88 **Fels, John E. and Thomas R. Wentworth.** (North Carolina State University) Predictive mapping of potential natural vegetation in the Southern Blue Ridge: a prototype study in the Ellicott Rock National Wilderness.
- 1:45 89 **Zartman, Charles E. and J. Dan Pittillo.** (Western Carolina University) A unique component of gorge vegetation: The spray cliff communities of the Chattooga River Gorge.
- 2:00 90 **Small, Christine J. and Thomas R. Wentworth.** (North Carolina State University) Characterization of Montane Cedar-Hardwood Woodlands in the Southern Blue Ridge Province.
- 2:15 91 **Newell, Claire L. and Robert K. Peet.** (University of North Carolina, Chapel Hill) Vegetation of Linville Gorge Wilderness.
- 2:30 92 **Wentworth, Thomas R. and Christopher J. Ulrey.** (North Carolina State University) Vegetation of the Thompson River watershed, North and South Carolina.
- 2:45 93 **Patterson, Karen D., Thomas R. Wentworth, J. Dan Pittillo, and Robert Dellinger.** (The Nature Conservancy, North Carolina State University, Western Carolina University, and Great Smoky Mountains National Park) Classification of vegetation in Ellicott Rock Wilderness, Southeastern Blue Ridge Escarpment.
- 3:00 **BREAK**
- 3:15 94 **Roberts, Stephen D., J. Dan Pittillo, Thomas R. Wentworth, Charles Zartman, and Chris Ulrey.** (Western Carolina University, North Carolina State University) Classification of old-growth communities of the Kelsey Natural Area, Southern Blue Ridge.
- 3:30 95 **Peet, Robert K., Gary Kauffman, Claire L. Newell, J. Dan Pittillo, Michael P. Schafale, Alan S. Weakley, and Thomas R. Wentworth.** (University of North Carolina, Chapel Hill, U.S. Forest Service, Western Carolina University, North Carolina Natural Heritage Program, The Nature Conservancy, and North Carolina State University) Vegetation of the Nantahala Mountains, North Carolina.
- 3:45 96 **White, Peter S., Mark D. Mackenzie, and Jonathan Harrod.** (University of North Carolina, Chapel Hill and Auburn University) The vegetation of Great Smoky Mountains National Park: Sources of landscape variation as seen in the Miller data set (1935-1937)

- 4:00 97 **Delcourt, Paul A. and Hazel R. Delcourt.** (University of Tennessee, Knoxville) Prehistoric pyromaniacs in the southern Appalachian oak-chestnut forest region.
- 4:15 98 **Harrod, Jonathan, Peter S. White, and Mark E. Harmon.** (University of North Carolina, Chapel Hill and Oregon State University) Changes in xeric forests in western Great Smoky Mountains National Park, 1936-1995.
- 4:30 99 **Busing, Richard T.** (Forestry Sciences Laboratory, Pacific Northwest Research Station) Structure and dynamics of cove forests in the Great Smoky Mountains.
- 4:45 100 **Bratton, Susan P. and Albert J. Meier.** (Whitworth College and University of Missouri-Columbia) Disturbance dynamics of the Chattooga River watershed.
- 5:00 101 **Pearson, Scott M., Alan B. Smith, and Monica G. Turner.** (Mars Hill College and University of Wisconsin, Madison) Forest fragmentation and patterns of plant diversity in western North Carolina.

ANIMAL ECOLOGY - *Redbud Suite*

Presiding: *Ronald E. Barry*, Frostburg State University

- 1:30 102 **Wilds, Stephanie P., C. Reed Rossell, Jr., and Irene M. Rossell.** (University of North Carolina at Asheville and Warren Wilson College) Avian species composition, landscape diversity, and vegetation structure in a partially disturbed Southern Appalachian forest-gap bog complex.
- 1:45 103 **Faith, Sheila C. and Gwenda L. Brewer.** (Frostburg State University) Effects of water fluctuations on egret interactions.
- 2:00 104 **King, Anthony W., Tom L. Ashwood, Virginia H. Dale, and Linda K. Mann.** (Oak Ridge National Laboratory) On the persistence of red-cockaded woodpecker, *Picoides borealis*, in the southeastern United States.
- 2:15 105 **Ritland, David B.** (Erskine College) Dual mimicry in the viceroy butterfly: a tale of two models.
- 2:30 106 **Brooks, Janie S. and Paul Feeny.** (Cornell University) Chemical signals on *Daucus carota* leaf surfaces: keys of recognition for the black swallowtail butterfly, *Papilio polyxenes*.
- 2:45 107 **Draney, Michael L.** (Savannah River Ecology Laboratory) Diversity of ground-dwelling spiders from eight South Carolina inner coastal plain habitats.

- 3:00 108 **Miller, Luitpold E.** (Appalachian State University) Daily activity patterns, habitat preference, and home range geometry of two species of scorpions, *Centruroides vittatus* and *Diplocentrus* sp.
- 3:15 **BREAK**
- 3:30 109 **Pack, Kari J.** (Appalachian State University) Effects of *Toxocara canis* on the secondary sex ratio of *Mus musculus*.
- 3:45 110 **Brannon, M. Patrick and R. Wayne Van Devender.** (Appalachian State University) Effects of microhabitat on shrew distributions.
- 4:00 111 **Mammone, Karen A. and Ronald E. Barry.** (Frostburg State University) Small mammal assemblages in structurally diverse clearcuts and adjacent woodlands in western Maryland.
- 4:15 112 **Dateo, Dorothy M., Francis L. Precht, and Ronald E. Barry.** (Frostburg State University) Influence of habitat selection by black bears *Ursus americanus* on crop depredation in western Maryland.
- 4:30 113 **Marsh, Brian and David Morton.** (Frostburg State University) Noninvasive examination of fat deposition strategies in temperate cave dwelling bats.
- 4:45 114 **Barnwell, Michael K., Gary Durrant, Kenneth Pilgreen, and George Cline.** (Jacksonville State University) A comparison of rete mirabilia in the maxilla and dentary bones of bottlenose dolphins, *Tursiops truncatus*, with rete mirabilia in the flukes.
- 5:00 115 **Durrant, Gary E., Michael Barnwell, and George R. Cline.** (Jacksonville State University) Using NOAA's CCOAST satellite imagery system in Biological Research and Education.

INVERTEBRATE ZOOLOGY - Regency E

Presiding: *Julian P.S. Smith*, Winthrop University

- 1:30 116 **Dobson, William E., Eileen Strahl, and Leon L. Lundie.** (Appalachian State University) Isolation and screening of subcuticular bacteria from *Amphiopholis gracillima* for antimicrobial activity.
- 1:45 117 **Reddy, Palla S., Shea R. Tuberty, and Milton Fingerman.** (Tulane University) Effects of cadmium and mercury on ovarian maturation in the red swamp crayfish, *Procambarus clarkii*: an *in vivo* and *in vitro* study.
- 2:00 118 **Perrine, Gail L. and Donald C. Tarter.** (Marshall University) Low pH tolerance of larval *Caenis amica* Hagen (Ephemeroptera: Caenidae) from a mitigated wetland in the Green Bottom Wildlife Area, West Virginia.

- 2:15 119 **Smith, Bradley E. and Jay A. Yoder.** (Illinois College) Transforming into a 'superorganism' by clustering promotes water conservation in certain ants, beetles, cockroaches, ticks, and mites.
- 2:30 120 **Fisher, Ginger R. and Ronald V. Dimock, Jr.** (Wake Forest University) The nutritional biology of *Unionicola formosa*.
- 2:45 121 **Watson, Brian T. and Richard J. Neves.** (Virginia Polytechnic Institute and State University) Life history characteristics of two Federally endangered freshwater mussels (family Unionidae).
- 3:00 122 **Neils, David E. and Richard J. Neves.** (Virginia Polytechnic Institute and State University) Translocation of freshwater mussels (family Unionidae) into the Holston River.
- 3:15 **BREAK**
- 3:30 123 **Heacock, Charles H.** (University of Tennessee) A study of freshwater mussels (Bivalvia Unionidae) of Little River, Blount County, Tennessee.
- 3:45 124 **Castano, Diana F.** (Appalachian State University) An examination of the subesophageal region and ventral trunk ganglia in *Echiniscus* sp.
- 4:00 125 **Tarter, Donald C., Diane R. Nelson, Erica S. Midkiff, and Eric S. Wilhelm.** (Marshall University and East Tennessee State University) First records of tardigrades (Phylum Tardigrada) from mosses in the New River Gorge, West Virginia.
- 4:15 126 **Gaugler, Michael S. and Diane R. Nelson.** (East Tennessee State University) Marine interstitial Tardigrada of Dauphin Island, Alabama.
- 4:30 127 **Hamilton, Robert IV, Janet W. Reid, and Richard M. Duffield.** (Howard University and Smithsonian Institution) Identification of Copepoda (Crustacea) in the leaves of the purple pitcher plant, *Sarracenia purpurea* L. (Sarraceniaceae).
- 4:45 128 **Scholtens, Brian G. and Joseph Reznik.** (College of Charleston) Status of the Lake Huron Locust (*Trimerotropis huroniana*), a Michigan threatened species, in the northern Great Lakes.
- 5:00 129 **Baldwin, Andrew S. and Richard N. Henson.** (Appalachian State University) The re-evaluation of the small *Diplocentrus* species in Texas.

EVOLUTION - Regency D

Presiding: *Martiu L. Cipollini*, Berry College

- 1:30 130 **Herr, J.M., Jr.** (University of South Carolina) Repetitive ontogeny in angiosperms and its unusual occurrence in the *bell-3* mutant of *Arabidopsis thaliana*.

- 1:45 131 **Drozda, Nicholas and Zack E. Murrell.** (Western Kentucky University) Variation and species boundaries in *Hexastylis heterophylla* (Ashe) Small.
- 2:00 132 **Murrell, Zack E., Partick E. Carroll, and Scott A. Myers.** (Western Kentucky University) Examination of species boundaries in *Hexastylis contracta* Blomquist and *H. rhombiformis* Gaddy using the Internal Transcribed Spacer (ITS) region of nuclear r-DNA.
- 2:15 133 **Unwin, Matthew and Linda E. Watson.** (Miami University of Ohio) The role of ecotypes in the speciation process: a molecular re-examination of the Clausen, Keck, and Heisey studies on *Achillea*.
- 2:30 134 **Strange, Rex Meade.** (University of Alabama) Mitochondrial DNA variation in Johnny Darters (Pisces: Percidae) from eastern Kentucky: stream capture and the origin of the Upper Cumberland River fish fauna.
- 2:45 **BREAK**
- 3:00 135 **Bone, Samantha J. and Roger Sauterer.** (Jacksonville State University) An electrophoretic study of two geographically isolated populations of *Elimia acutocarinata* (Lea 1841).
- 3:15 136 **McElroy, Tom C. and Walter J. Diehl.** (Mississippi State University) Coarse-grained spatial environmental heterogeneity, allozyme heterozygosity, and growth in the earthworm *Eisenia fetida andrei*.
- 3:30 137 **Jhee, Edward M. and A. Joseph Pollard.** (Furman University) Feeding responses of *Pieris napi* (Lepidoptera) to genetic variation in zinc content of *Thlaspi caerulescens* (Brassicaceae).
- 3:45 138 **Pollard, A. Joseph** (Furman University) Deterrence and toxicity of hyperaccumulated heavy metals to generalist and specialist herbivores.
- 4:00 139 **Sanders, Anna K., Sofia Wahaj, Douglas J. Levey, and Martin L. Cipollini.** (Berry College and University of Florida) A test of the fruit laxative hypothesis in *Solanum americanum*: Do glycoalkaloids hasten seed passage in birds?

PARASITOLOGY - *Regency B,C*

Presiding: *Amy Crews-Oyen*, University of North Alabama

- 1:30 140 **Scott, Jon B. and James E. Joy.** (Marshall University) Parasites of the Snapping Turtle, *Chelydra serpentina*, from western West Virginia.
- 1:45 141 **Tucker, R.B. and J.E. Joy.** (Marshall University) Symbionts of *Plethodon punctatus* and *Plethodon wehrlei* from eastern West Virginia.

- 2:00 142 **Emery, M. and J.E. Joy.** (Marshall University) Helminth parasites of the ravine salamander, *Plethodon richmondi*, in Wayne County, West Virginia.
- 2:15 143 **Crank, C. and J. Joy.** (Marshall University) *Plagitura* spp. (Trematoda: Digenea) in red-spotted newts from western West Virginia.
- 2:30 144 **Schotthoefer, Anna and Gerald W. Esch.** (Wake Forest University) Changes within a guild of trematodes and their effects on community structure in the pulmonate snail, *Physa gyrina*.
- 2:45 145 **Zelmer, Derek A., Eric J. Wetzel, and Gerald W. Esch.** (Wake Forest University and Wabash College) The role of habitat in the structuring of the *Halipegus occidualis* metapopulation of the green frog, *Rana clamitans*.
- 3:00 **BREAK**
- 3:15 146 **Benz, George W., Nick Caloyianis, and Adam Ravetch.** (Southeast Aquatic Research Institute, Tennessee Aquarium, Nick Caloyianis Productions, Inc., and Ravetch Underwater Films) Copepods that attach to the eyes of Greenland sharks – are they lures that attract prey?
- 3:30 147 **Dee, Jennie L., George W. Benz, Ryan Otting, and Greg Skomal.** (Southern Adventist University, Southeast Aquatic Research Institute, Tennessee Aquarium, University of Georgia at Athens, and Massachusetts Division of Marine Fisheries) Resource partitioning of the smooth dogfish by two species of parasitic copepods.
- 3:45 148 **Bullard, Stephen A., Jeffrey S. Braswell, and George W. Benz.** (Southeast Aquatic Research Institute, University of South Carolina, E.I. DuPont deNemours and Co., and Tennessee Aquarium) First report of oncomiracidia of genus *Dermophthirius*.
- 4:00 149 **Soucek, David J. and Gayle P. Noblet.** (Clemson University) Effects of copper contamination on recruitment of *Posthodiplostomum minimum* (Trematoda) by bluegill sunfish (*Lepomis macrochirus*).
- 4:15 150 **Font, William F. and Mark C. Rigby.** (Southeastern Louisiana University and University of Alberta) Occurrence of *Spirocamallanus isitblenni* in tidepool and stream fishes of Hawai'i.

CRYPTOGAMIC BOTANY - Dogwood Suite

Presiding: *Charles R. Werth*, Texas Tech University

- 1:30 151 **Musselman, Lytton J. and Kerry D. Heafner.** (Old Dominion University) Monograph of Southeastern *Isoetes*.
- 1:45 152 **McHenry, Diana J. and Kerry D. Heafner.** (Old Dominion University) Electrophoretic studies of some southeastern quillworts (*Isoetes* spp.).

- 2:00 153 **Russell, Cameron L. and Rebecca D. Bray.** (Old Dominion University) A comparative study of *Isoetes boomii* and *Isoetes georgiana*.
- 2:15 154 **Barr, Aaron D. and Lytton J. Musselman.** (Old Dominion University) New hybrids in the genus *Isoetes* (quillworts) in the southeastern United States.
- 2:30 155 **Bray, Rebecca D. and Lytton J. Musselman.** (Old Dominion University) Autopolyploidy in quillworts of the southeastern United States.
- 2:45 **BREAK**
- 3:00 156 **Burke, Ian C.** (Old Dominion University) Occurrence, density, and topography of stomata in Virginia quillworts (*Isoetes*).
- 3:15 157 **Caplen, Cynthia A. and Charles R. Werth.** (Texas Tech University) Isozymic comparison of some diploid *Isoetes* species of eastern North America.
- 3:30 158 **McCleneghan, S. Coleman.** (Appalachian State University) The *Pholiota alnicola* complex: a taxonomic revision.
- 3:45 159 **McGuire, Robert F. and Davinderjit K. Bagga.** (University of Montevallo) A rethinking of the number of algal divisions.

PLANT ECOLOGY - Regency F

Presiding: *Rebecca R. Sharitz*, Savannah River Ecology Laboratory

- 1:30 160 **Turrill, Nicole and Edward Buckner.** (University of Tennessee) Restoring Southern Appalachian *Pinus rigida* communities with prescribed fire.
- 1:45 161 **Imm, Donald W. and Barbara P. Moyer.** (Savannah River Forest Station and Savannah River Ecology Laboratory) Changes in distribution and productivity patterns of *Sarracenia minor* following fire.
- 2:00 162 **Suchecki, Sharon R. and Philip A. Robertson.** (Southern Illinois University at Carbondale) Response of herbaceous species to experimental restoration of a limestone glade, Monroe County, Illinois.
- 2:15 163 **Battaglia, Loretta L. and Rebecca R. Sharitz.** (Savannah River Ecology Laboratory) Post-disturbance regeneration patterns in bottomland hardwood forests: the role of microsite heterogeneity.
- 2:30 164 **Greenberg, Cathryn H. and Henry McNab.** (USDA Forest Service) Forest disturbance in hurricane-related downbursts in the southern Appalachian mountains of North Carolina.

- 2:45 165 **Tuberville, Tracey D.** (University of Georgia) Effects of gopher tortoise (*Gopherus polyphemus*) burrows on herbaceous vegetation in the longleaf pine-wiregrass community.
- 3:00 **BREAK**
- 3:15 166 **Adams, Eric D., Paul Rothrock, and Edwin Squiers.** (Southern Illinois University at Carbondale and Taylor University) The development of a reconstructed prairie and possible flood effects (year two).
- 3:30 167 **Glickauf, Steven and James Fralish.** (Southern Illinois University) Herbaceous richness and cover in shelterwood cut forest stands at Land Between the Lakes, Kentucky and Tennessee.
- 3:45 168 **Basinger, Mark A. and Philip A. Robertson.** (Southern Illinois University at Carbondale) Response of the vascular flora in an old-growth forest in the Ozark Hills of southern Illinois to selective timber harvest.
- 4:00 169 **Basinger, Mark A. and Philip A. Robertson.** (Southern Illinois University at Carbondale) Response of herbaceous vegetation to selective timber harvest in an old-growth forest remnant in the Ozark Hills of southern Illinois.
- 4:15 170 **Arnold, Amy E.** (University of Tennessee) Influence of microenvironment on growth and nutrient of three herbaceous species in a lower montane rain forest.
- 4:30 171 **McCormick, Frank.** (University of Tennessee) Sustainable forestry in the Amazon.

MIXER/DISCUSSION - *Gardenia Snite*

Sponsored by the Ecological Society of America, Southeastern Chapter

- 4:30 Minority Recruitment in Organismal Biology (see description page 31)

Friday Morning, April 18, 1997

PLANT ECOLOGY I - *Regency A*

Presiding: *Clandia L. Jolls*, East Carolina University

- 8:00 172 **Taylor, David D.** (USDA Forest Service) Observations on populations of Appalachian monkey-face orchid, *Platanthera integrilabia*, after two years of census.
- 8:15 173 **Crock, Christopher J., Lawrence W. Zettler, and Daniel J. Wyrick.** (Furman University, Illinois College, and USDA Forest Service) Factors contributing to the enormity of an orchid population in the southern Blue Ridge of Tennessee.

- 8:30 174 **Johnson, Margaret A. and Philip A. Robertston.** (Southern Illinois University at Carbondale) Environmental factors associated with growth and reproduction of *Matelea obliqua* in southern Illinois.
- 8:45 175 **Hamzé, Samara I. and Claudia L. Jolls.** (East Carolina University and University of Michigan Biological Station) The distribution of seedlings of the Great Lakes endemic *Cirsium pitcheri*.
- 9:00 176 **Lin, Tiffany S. and Claudia Jolls.** (University of Michigan Biological Station and East Carolina University) Apical meristem damage and reproductive output of *Cirsium pitcheri*, a rare endemic plant of the Great Lakes dunes.
- 9:15 177 **Davis, J. Eric Jr. and Lawrence S. Barden.** (University of North Carolina, Charlotte) Restoration of a Piedmont prairie: potential species composition and demographics of the Federally endangered sunflower, *Helianthus schweinitzii* T&G (Asteraceae).
- 9:30 **BREAK**
- 9:45 178 **Cunningham, Maureen and Mitchell B. Cruzan.** (University of Tennessee, Knoxville and Oak Ridge National Laboratory) Demographic trends and host interactions of the rare hemiparasite, *Aureolaria patula* (Chap.) Pennell (Scrophulariaceae).
- 10:00 179 **Fairey, John E. III and David W. Bradshaw.** (Clemson University) Success of transplants from the basin of the Richard B. Russell Lake: a final report.
- 10:15 180 **Edwards, Lonnelle G. and Joan L. Walker.** (Clemson University and USDA Forest Service) Population structure of *Echinacea laevigata*, a Federally endangered species.
- 10:30 181 **Walker, Joan L. and Dana L. Madsen.** (USDA Forest Service) The breeding system of *Macbridea alba*, a Federally threatened mint.
- 10:45 182 **Horn, Charles N. and Lee Ringer.** (Newberry College and Coker College) An ecological study of the sedge *Carex prasina*, rare to the piedmont of South Carolina.
- 11:00 183 **Rae, John G.** (Francis Marion University) Predicting the population growth of an endangered cactus by transition matrices.

PLANT ECOLOGY II - Regency B,C

Presiding: *Douglas R. Rayner*, Wofford College

- 8:45 184 **Stephenson, Steven L., Gary A. Laursen, and Rodney D. Seppelt.** (Fairmont State College, University of Alaska, Fairbanks, and Australian Antarctic Division) Subantarctic Macquarie Island.

- 9:00 185 **Rollins, Sarah C. and Peter S. White.** (University of North Carolina, Chapel Hill) Calcareous glade communities in the Central Basin of Tennessee.
- 9:15 186 **Close, David D. and James S. Fralish.** (Southern Illinois University at Carbondale) Herbaceous dominance types and species response to an environmental gradient for undisturbed forest stands at Land Between the Lakes, Kentucky and Tennessee.
- 9:30 187 **McCoy, Roger A. and Philip A. Robertson.** (Southern Illinois University at Carbondale) Community types of Atwood Ridge Research Natural Area, Union County, Illinois.
- 9:45 188 **Barden, Lawrence S.** (University of North Carolina at Charlotte) Historic prairies in the Piedmont of North and South Carolina.
- 10:00 **BREAK**
- 10:15 189 **Franklin, Scott B. and Päivi Paalamo.** (Southern Illinois University, Carbondale and University of Joensuu) Field and bottom strata spatial patterns in an old-growth *Myrtillus* forest, North Karelia, Finland.
- 10:30 190 **Cline, George R., R. David Whetstone, Frank A. Romano III, Steven J. Threlkeld, Jason R. Adams, and Eric A. Blackwell.** (Jacksonville State University) Quantitative analysis of selected northeastern Alabama tree communities: topographic effects on Fort McClellan, Calhoun County.
- 10:45 191 **Carter, Robert E., Jr., Mark D. Mackenzie, and Dean H. Gjerstad.** (Auburn University) Integrated land classification in the uplands of the Southern Loam Hills of south Alabama: longleaf pine ecosystems.
- 11:00 192 **Coulling, Philip P.** (University of North Carolina at Chapel Hill) A comparison of plant species richness patterns in high-elevation *Quercus rubra* forests in Shenandoah National Park and the George Washington National Forest, Virginia.
- 11:15 193 **Booth, Robert K., Donald J. Drapalik, and Frederick J. Rich.** (Georgia Southern University) Identification and paleoenvironmental and paleoecological implications of a Late Pleistocene fossil fern spore from St. Catherines Island, Georgia.

PARASITOLOGY - Regency D

Presiding: *Cheryl D. Davis and Jeff Sizemore*, Western Kentucky University

- 8:00 194 **Coffer, Natalie J. and Jeffrey A. Butts.** (Appalachian State University) The prevalence of heartworm in domestic and feral dogs in Watauga County.

- 8:15 195 **Blagburn, Byron L., Joy L. Vaughan, Jamie M. Butler, David S. Lindsay, and Thomas A. Miller.** (Auburn University and Virbac, Inc.) The entomopathogenic fungus, *Beauveria bassiana*, inhibits development of insectary-reared cat fleas, *Ctenocephalides felis*.
- 8:30 196 **Jones, Robert M. and Laura J. Fielden.** (Berry College) The effect of blood feeding on respiratory gas exchange in ticks.
- 8:45 197 **Meader, Lisa L., Jonathan M. Sleema, Antoine B. Mudakikwa, and Sharon Patton.** (University of Tennessee and Mountain Gorilla Veterinary Center) Prevalence of gastrointestinal parasites in gorillas from the Virunga Mountains in Kigali, Rwanda, Africa.
- 9:00 198 **Faulkner, Charles T., C.S. Mayes, S.E. Cowie, P.E. Martin, and Sharon Patton.** (University of Tennessee College of Veterinary Medicine and Michigan Technological University) Examination of privy deposits from the 19th century company town of Fayette, Michigan (20DE19) for endoparasitic infection.
- 9:15 **BREAK**
- 9:30 199 **Mohamed, Fawzi, José V. deSantana, Elizabeth Malagueño, Adriana Telles, Vladia Costa, Nadjar Silva, Daniel J. Murfin, and Raymond T. Damian.** (University of Georgia and Universidade - Federal de Pernambuco) Experimental *Schistosoma mansoni* infection in the common marmoset (*Callithrix jacchus*).
- 9:45 200 **Chou, Tien-Min, Roger W. Stich, Jacek Gaertig, Christine Marsala, Fawzi Mohamed, and Raymond T. Damian.** (University of Georgia) Development of a molecular probe for baboon interleukin-10 to study experimental schistosomiasis.
- 10:00 201 **Connors, Vincent A., Isaure deBuron, José Jourdane, Andre Théron, Willard O. Granath, and Anne Agner.** (University of South Carolina, University of Montana, Missoula, and University of Perpignan) Interleukin-1 mediated killing of *Schistosoma mansoni* primary sporocysts in susceptible strains of the snail host, *Biomphalaria glabrata*.

HERPETOLOGY - Regency E

Presiding: **George R. Cline,** Jacksonville State University

- 8:00 202 **Pauley, Thomas K.** (Marshall University) Study of a relocated population of *Plethodon nettingi* Green.
- 8:15 203 **Tucker, Robert B., Thomas K. Pauley, and Joseph C. Mitchell.** (Marshall University and University of Richmond) Notes on the natural history and ecology of *Plethodon punctatus* Highton.

- 8:30 204 **Piasecik, Jennifer and Thomas K. Pauley.** (Marshall University) Natural history notes of *Notophthalmus v. viridescens* in West Virginia.
- 8:45 205 **Paxton, Barton J., Thomas K. Pauley, Stephen B. Horsley, and David Decalesta.** (Marshall University and Northeastern Forest Experiment Station) Effects of lime, deer exclusion, and herbicide on terrestrial salamanders in the Susquehannock State Forest, Pennsylvania.
- 9:00 206 **Mitchell, Joseph C.** (University of Richmond) Monitoring amphibians in the Blue Ridge Mountains of Virginia: effects of acidification and floods.
- 9:15 **BREAK**
- 9:30 207 **Adams, Jason R. and George R. Cline.** (Jacksonville State University) A preliminary study of the amphibians and reptiles of Fort McClellan, Calhoun County, Alabama.
- 9:45 208 **Blackwell, Eric A. and George R. Cline.** (Jacksonville State University) A preliminary study of salamander population dynamics at a northeastern Alabama pond.
- 10:00 209 **Lapp, Kevin D. and R.W. Van Devender.** (Appalachian State University) Seasonal activity of a terrestrial salamander community in northwest North Carolina.
- 10:15 210 **Buhlman, Kurt A.** (University of Georgia's Savannah River Ecology Laboratory) Reproductive biology and ecology of the chicken turtle *Deirochelys reticularia*.
- 10:30 211 **Morrow, Jessica L. and James Howard.** (Frostburg State University) Home range and movements of the bog turtle, *Clemmys muhlenbergii*, in Harford County, Maryland.
- 10:45 212 **Dills, Melissa D., William K. Michener, and Craig Guyer.** (J.W. Jones Ecological Center and Auburn University) Dispersion of *Gopherus polyphemus* burrows with regard to microhabitat parameters in a longleaf pine ecosystem.
- 11:00 213 **Mills, Mark S.** (University of Georgia, Savannah River Ecology Laboratory) Demography and growth of the brown water snake, *Nerodia taxispilota*.
- 11:15 214 **Matter, John M., Cynthia Sills-McMurry, and Richard L. Dickerson.** (TIWET, Clemson University) Xenobiotic contaminants alter sex determination of in ovo-exposed American alligators (*Alligator mississippiensis*).

AQUATIC AND WETLAND ECOLOGY - Regency F

Presiding: **Gary Wein**, Savannah River Ecology Laboratory

- 8:00

215

Midkiff, Erica S. and Donald C. Tarter. (Marshall University) Comparative ecological studies on the diet and growth rates of larval and juvenile grass pickerel, *Esox americanus vermiculatus*, and central mudminnow, *Umbra limi*, and fall spawning of the grass pickerel in the Green Bottom Wildlife Management Area, West Virginia.
- 8:15

216

Russell, Ann M., Ron C. Ahle, and Albert B. Pittman. (South Carolina Department of Natural Resources) Fish survey of pocosin habitats in the sandhills of South Carolina.
- 8:30

217

Sharp, Homer F. and Steve Baker. (Oxford College of Emory University) Historical changes in the benthic macroinvertebrate community structure of Dried Indian Creek, Newton County, Georgia.
- 8:45

218

Medland, Vicki L. and Barbara E. Taylor. (University of Georgia, Savannah River Ecology Laboratory) Impact of climate variability on the success of life history strategies of diapausing cyclopoid copepods.
- 9:00

219

Hood, Robert W., Donald C. Tarter, and Ted R. Angradi. (Marshall University and Northeastern Forest Experiment Station) Longitudinal, vertical, and seasonal variation of the interstitial macroinvertebrate fauna at the Fernow Experimental Forest, Parsons, West Virginia.
- 9:15

220

Brittingham, Kevin D., Donald C. Tarter, and Ted R. Angradi. (Marshall University and Northeastern Forest Experiment Station) A comparative study of the benthic populations in weir ponds draining watersheds of the Fernow Experimental Forest, Parsons, West Virginia.
- 9:30

221

Wilhelm, Eric S., Kevin D. Brittingham, Erica S. Midkiff, and Donald C. Tarter. (Marshall University) Population dynamics of Chironomidae in Green Bottom Wildlife Management Area, Cabell County, West Virginia with notes on Chironomidae of West Virginia.
- 9:45

BREAK
- 10:00

222

Mayne, Christopher D. and William Pegg. (Frostburg State University) The fall turnover limnology of a man-made West Virginia lake.
- 10:15

223

Hupp, Cliff R. and Michael R. Schening. (United States Geological Survey) Patterns of sedimentation and woody vegetation along black- and brown-water riverine forested wetlands.
- 10:30

224

Weaver, Warren T. (Southern Illinois University at Carbondale) Vegetation in restored and natural wetlands in the Sandhills of Nebraska.

- 10:45 225 **Hamilton, Ashley K., Mark D. MacKenzie, and B. Graeme Lockaby.** (Auburn University) Cumulative impacts of multiple land uses on water quality in the Sepulga River watershed of Alabama.
- 11:00 226 **Norris, Amy R. and Courtney T. Hackney.** (University of North Carolina-Wilmington) Silica content of intertidal marshes in the Cape Fear River Estuary, North Carolina.
- 11:15 227 **Egleston, D. DuBose.** (Furman University) Management of a limited-entry fishery: prediction of fall channel net shrimp catches in Winyah Bay, South Carolina.

WORKSHOP - *Magnolia Suite*

Sponsored by the Botanical Society of America, Southeastern Section

- 8:00 228 **Cruzan, Mitchell B.** (University of Tennessee, Knoxville) Application of Recent Technological Advances to Plant Mating Studies.

Friday Afternoon, April 18, 1997

TEACHING BIOLOGY - *Gardenia Suite*

Presiding: *W. Dean Cocking*, James Madison University

- 1:30 229 **Alkaff, Huda F.** (University of Georgia) An exploratory study of students' perceptions of environmental literacy in higher education.
- 1:45 230 **Knauper, Beverly A.** (University of Cincinnati) The use of primary trait scoring as an assessment tool.
- 2:00 231 **Jones, Jody.** (Jacksonville State University) Alabama science in motion: making the connection.
- 2:15 232 **Swab, Janice C.** (Meredith College) "Science and religion" courses as opportunities for consideration of controversial topics.
- 2:30 233 **Cook, Rebecca A. and Kenneth D. McFarland.** (Monmouth College and University of Tennessee, Knoxville) Use of modeling clay to illustrate plant structures and developmental processes.
- 2:45 234 **Aliff, John V.** (DeKalb College-Gwinnett) Study Guides and Notes for Anatomy and Physiology: guidelines for preparation and use by first-year students.

PLANT SYSTEMATICS - Regency D

Presiding: *James F. Matthews*, University of North Carolina, Charlotte

- 2:00 235 **Pittman, Albert B., Katherine A. Boyle, Ann R. Darr, Francois Smith, and Cynthia A. Smith.** (South Carolina Department of Natural Resources) Vegetation of sandhill streamhead pocosins at Fort Jackson, South Carolina.
- 2:15 236 **Pittman, Albert B.** (South Carolina Department of Natural Resources) A new species of *Lobelia* (Campanulaceae) from the Carolina Sandhills.
- 2:30 237 **Allison, James R.** (Georgia Department of Natural Resources) Rediscovery of the whorled sunflower, *Helianthus verticillatus* Small.
- 2:45 238 **Houser, Crystal C., James F. Matthews, and Christopher R. Matthews.** (University of North Carolina, Charlotte and HDR Engineering) *Helianthus verticillatus* rediscovered.
- 3:00 239 **Noel, William, L.L. Gaddy, and John E. Fairey, III.** (Clemson University) Floristic study of the Tallulah Gorge.
- 3:15 **BREAK**
- 3:30 240 **Stalter, Richard.** (St. John's University) The vascular flora of Sagamore Hill National Historic Site, Long Island, New York.
- 3:45 241 **Seckinger, George W., Jr. and John B. Nelson.** (University of South Carolina) Vascular plant survey of the Prince George Tract, Georgetown County, South Carolina.
- 4:00 242 **Hill, Steven R.** (Illinois Natural History Survey) The prairie element in the flora of Oconee County, South Carolina.
- 4:15 243 **Evans, Dan K.** (Marshall University) Botany and brujos: traditional healing with plants and magic among the indigenous Shuar and Achuar people of southeastern Ecuador.

ICHTHYOLOGY - Regency E

Presiding: *Stephen J. Walsh*, US Geological Survey

- 1:30 244 **Rohde, Fred C., Joseph M. Quattro, and Rudolf G. Arndt.** (University of South Carolina and the Richard Stockton College of New Jersey) To be or not to be: the case of *Etheostoma saluda*.
- 1:45 245 **Stoll, Syam, Patrick Anderson, Michael Little, and John Wiley.** (Marshall University and East Carolina University School of Medicine) Ribosomal gene and telomere locations in the cyprinid fishes, *Rhinichthys cataractae* and *Nocomis micropogon*.

- 2:00 246 **McGuire, William R., Eugene G. Maurakis, and William S. Woolcott.** (St. Christopher's School, Science Museum of Virginia, University of Richmond) Cephalic skin morphology of tuberculate male *Semotilus atromaculatus*.
- 2:15 247 **Menhinick, Edward F.** (University of North Carolina at Charlotte) A study of the fishes of the Uwharrie National Forest.
- 2:30 248 **Piller, Kyle R., David J. Eisenhour, and Brooks M. Burr.** (Southern Illinois University at Carbondale and Tulane Museum of Natural History) Status survey of the sturgeon chub, *Macrhybopsis gelida* and the sicklefin chub, *M. meeki*, in the middle Mississippi River, Illinois.
- 2:45 249 **Bart, Henry L., Jr. and Royal D. Suttkus.** (Tulane Museum of Natural History) Conservation status of the Pearl darter, *Percina aurora*.
- 3:00 **BREAK**
- 3:15 250 **Jones, Dale B., Josh O. Harper, and Gene S. Helfman.** (University of Georgia) The effects of land use on fish assemblages and stream habitats in the Little Tennessee River drainage.
- 3:30 251 **Petty, J. Todd and Gary D. Grossman.** (University of Georgia) Patch selection by mottled sculpin, *Cottus bairdi*, in a southern Appalachian stream.
- 3:45 252 **Neely, David A.** (University of Alabama) A contact zone between two allopatric forms of the mottled sculpin, *Cottus bairdi*: a test of species boundaries within the complex.
- 4:00 253 **Rogers, Jason.** (University of North Carolina at Wilmington) Age and growth of pelagic larvae and juveniles of the reef fish *Monacanthus hispidus*.
- 4:15 254 **Haney, Dennis C., Stephen J. Walsh, Frank G. Nordlie, Tina L. Yanchis, and Cindy M. Timmerman.** (Furman University, National Biological Service, University of Florida, and Florida Museum of Natural History) The influence of salinity on osmoregulation and temperature tolerance in the sheepshead minnow, *Cyprinodon variegatus*.
- 4:30 255 **Powell, Allyn, David Lindquist, and Jon Hare.** (NOAA and University of North Carolina at Wilmington) Larval and pelagic juvenile fishes collected with three types of gear in Gulf Stream and shelf waters off North Carolina.
- 4:45 256 **Schwartz, F.J. and J. Hurst.** (University of North Carolina) My, what big teeth you have - Ma.

PLANT ECOLOGY - Regency F

Presiding: *William H. Conner*, Baruch Forest Science Institute

- 2:00 257 **Miller, Susan P.** (University of Georgia Savannah River Ecology Laboratory) Nutrient limitations in dystrophic systems: do dominant Carolina bay grasses have inherently low growth rates?
- 2:15 258 **Corbin, Jeffrey D.** (University of North Carolina at Chapel Hill) The effects of three years of nitrogen and phosphorous addition on a deciduous forest understory community and soil nitrogen availability.
- 2:30 259 **Levi, Jeff A. and William J. Pegg.** (Frostburg State University) Nodulation of *Trifolium pratense* in fluidized bed ash amended strip mine reclamation soil: *in vitro*.
- 2:45 260 **McCarron, James K., Kenneth W. McLeod, and William H. Conner.** (Savannah River Ecology Laboratory and Baruch Forest Science Institute) Effects of flooding and salinity on swamp tupelo (*Nyssa sylvatica*) and buttonbush (*Cephalanthus occidentalis*).
- 3:00 261 **McLeod, Kenneth W., James K. McCarron, and William H. Conner.** (Savannah River Ecology Laboratory and Baruch Forest Science Institute) Flooding and salinity effects on four bottomland oak species.
- 3:15 **BREAK**
- 3:30 262 **Hackney, Courtney T. and Kimberly Schlipper.** (University of North Carolina at Wilmington) Factors affecting the distribution of Spanish Moss, *Tillandsia usneoides*, in Southeastern North Carolina.
- 3:45 263 **McDonald, Amanda A. and Courtney T. Hackney.** (University of North Carolina at Wilmington) The role of calcium in the distribution of Spanish Moss, *Tillandsia usneoides*, in a developed landscape in southeastern North Carolina.
- 4:00 264 **Collins, Beverly and Gary Wein.** (Savannah River Ecology Laboratory) Effects of soil resource patchiness on vegetation structure.
- 4:15 265 **Winstead, Joe E. and John T. Riley.** (Morehead State University and Western Kentucky University) Soil and vegetation changes over thirty-eight years on an orphan coal spoil bank in southeastern Ohio.

SYMPOSIUM - Regency B,C**The Importance of Cliff-Face Communities in Plant Ecology**

Presiding: *Gary L. Walker*, Appalachian State University

- 2:30 266 **Walker, Gary L.** (Appalachian State University) Disjunct cliff face populations of northern white cedar (*Thuja occidentalis* L.) as genetic repositories during interglacial periods.

- 3:00 267 **Young, John M.** (Appalachian State University) The ecology and genetic structure of northern white cedar (*Thuja occidentalis* L.) cliff populations in its southern disjunct range.
- 3:30 268 **Clebsch, Edward E.C.** (The University of Tennessee, Knoxville) Plant disjunctions in cliff face communities.
- 4:00 269 **Larson, D.W.** (University of Guelph) Progress and opportunities for cliff ecology at the small and large scale.

ASB TEACHING WORKSHOP - *Gardenia Suite*

Sponsored by the ASB Education Committee

- 3:10 270 **Cocking, W. Dean.** (James Madison University) Active learning and projected computer presentation packages in large lecture biology classes.

BETA BETA BETA BIOLOGICAL SOCIETY

The following papers are not listed in the order in which they will be presented. The schedule for these presentations will appear in the Beta Beta Beta program available at the meeting.

SOUTHEASTERN REGION DISTRICT 1

Valoras, Danielle. (Sigma Phi, Guilford College) Isolation and identification of bacteria responsible for a recalcitrant paw infection in a domestic cat..

Geverd, Dawn. (Tau Eta, Catawba College) Dimorphism in *Saccaromyces cerevisiae* and *Schizosaccaromyces pombe* on a nitrogen limited medium.

Vedeikis, Erica. (Tau Eta, Catawba College) The effect of cytoskeleton inhibitors on the dynamics of *Physarum polycephalum* shuttle streaming.

Capraro, Gerald A. (Tau Eta, Catawba College) The dynamics of purring in the cat: *Felis domestica*.

Albright, Wendy J. (Tau Eta, Catawba College) Infrared thermography of regional heterothermy due to sports injury.

Clarkson, Francis Ancrum. (Sigma Gamma, Erskine College) RTI-55 and cocaine: their relationship to and effects on dopamine release in the nucleus accumbens of the rat.

Ellis, Jana. (Sigma Gamma, Erskine College) A study of the eastern box turtle, *Terrapene carolina*, in an urban setting.

Rodillo, Ellen E. (Sigma Gamma, Erskine College) Psychoactive drugs: functional mapping in rat brain using fos immunohistochemistry as a dynamic marker of brain activity.

Shults, Amber and Melissa Sprenne. (Sigma Gamma, Erskine College) Potential for *Agrobacterium tumefaciens* - mediated transformation of *Camellia* species.

Badgett, Carla Jan and Rosanne Spolski. (Beta Rho, Wake Forest University) The role of helix-loop-helix transcription factors in T-cell development.

Chavis, Kenyon, Eric Wetzel, and Derek Zelmer. (Beta Rho, Wake Forest University) The effect of age, temperature, and glycogen utilization on infectivity of *Halipegus occidualis* in its ostracod second intermediate host.

Kiehl, Allison and David Anderson. (Beta Rho, Wake Forest University) A phylogenetic analysis of sexual size dimorphism in birds.

Bryan, John F. (Tau Nu, The Citadel) The response of selected *Aedes* mosquitoes to *Aedes taeniorhynchus* oviposition trap.

Butler, Jennifer R. (Psi, Winthrop University) Comparative probing behavior of leaffooted bugs (Hemiptera: Coreidae) and brown stink bugs (Hemiptera: Pentatomidae) on tomato.

Kowalczyk, Tanya L. (Psi, Winthrop University) Interactions between deBrazza's monkeys (*Cercopithecus neglectus*) and black-and-white colobus monkeys (*Colobus guereza*) in Kisere Forest, Kenya.

Paysen, Eric S. (Psi, Winthrop University) The response of leaffooted bug, *Leptoglossus phyllopus*, (Hemiptera: Heteroptera: Coreidae) eggs to constant temperatures.

Thielen, Thomas E. (Psi, Winthrop University) Scanning confocal laser microscope detection of gut musculature in the free-living flatworm, *Stenostomum tenuicaudatum*.

Chapman, Elandee Vernell. (Psi, Winthrop University) Effects of retinoic acid in the early development of zebrafish (*Brachydanio rerio*).

Garcia, Gerald J., Hana Holubec, David L. Earnest, and Mark Nelson. (Tau Phi, North Carolina Agricultural and Technical State University) Effects of selenium on the induction and growth characteristics of premalignant aberrant crypt foci in rat colon.

Campbell, Jennifer L. (Tau Iota, UNC-Chapel Hill) Studies of the p18 cell cycle inhibition in mouse liver and during embryogenesis.

Teeters, John C. (Tau Iota, UNC-Chapel Hill) Effect of the ATM gene in p53 dependent or choroid plexus apoptosis and tumor progression.

Beck, Timothy S., Betsy L. Fajen, and William S. Irby. (Tau Kappa, Georgia Southern University) Bloodmeal sources of *Culex erraticus*, a suspected vector of eastern equine encephalitis virus.

SOUTHEASTERN REGION DISTRICT 2

Zimlich, M.A. and S.C. Landers. (Mu Epsilon, Troy State University) Morphological variants of apostome ciliated protozoa from Dauphin Island, Alabama.

Gifford, J. David. (Beta Zeta, University of North Alabama) Effect of heat stress on induction of heat shock proteins and on the immune status of the Asiatic clam, *Corbicula fluminea*.

Whetstine, Johnathan R. and Sigrid Jacobshagen. (Mu Gamma, Western Kentucky University) The study of circadian rhythms of messenger RNA levels in *Chlamydomonas reinhardtii*.

Dunne, Lori A. (Eta Lambda, Loyola University) DNA sequence and morphological variations in the *Synura petersenii* complex.

Engelke, Debra. (Eta Lambda, Loyola University) Comparison of microscopy and PCR in detection of *Trypanosoma cruzi* in vector samples.

Vargas, Juan Carlos. (Eta Lambda, Loyola University) In vitro development of the mosquito stages of *Plasmodium gallinaceum*.

Pollard, Penny and Roger Sauterer. (Mu Phi, Jacksonville State University) Preliminary electrophoretic analysis of control and cryptobiotic tardigrades.

Maitre, Michelle. (Mu Iota, Northern Kentucky University) The effect of stromelysin-2 expression by stromal and epithelial cells on the metastatic potential of breast neoplasms.

Jaskowiak, Megan. (Mu Iota, Northern Kentucky University) Diatom deformities in the Little Miami River, Ohio.

Dusing, Michael William. (Mu Iota, Northern Kentucky University) Correlation of interferon-induced cytostasis with epidermal growth factor differentiation between normal and breast cancer cell lines.

Allen, Peter. (Mu Iota, Northern Kentucky University) Acoustical signaling, mating effort, and mate choice in the "wing-banger" cicada *Platypedia mohavensis*.

Stricker, Julie, Dave Gearding, Dan Keaton, and Chris Vires. (Mu Iota, Northern Kentucky University) Vanadyl sulfate: anabolic or anti-beneficial?

Bone, Samantha J. (Mu Phi, Jacksonville State University) An electrophoretic study of two geographically isolated populations of *Elimia acutocarinata*.

Brown, Andy. (Kappa Pi Chapter, Millsaps College) Scanning electron microscopy analysis of the incidence of uterine cilia in garter snake following treatment with estradiol and/or progesterone.

Frascogna, Nan. (Kappa Pi, Millsaps College) Changes in expression of platelet-driven growth factor-related proteins during mouse muscle cell differentiation.

Lang, Gene. (Kappa Pi, Millsaps College) Generation of suppressors of nimx mutations in *Aspergillus nidulans*.

Mills, Melinda. (Kappa Pi, Millsaps College) Flow karyotyping and sorting of catfish B-cell chromosomes.

Smiley, Lane M. (Kappa Pi, Millsaps College) Voltage and length tension curves of a pregnant uterus in the garter snake.

Wahrle, Suzanne. (Kappa Pi, Millsaps College) Fluid dynamics of plant nutrient delivery systems in microgravity.

Love, Cardelia A. (Eta Mu, Southern University and A&M College and Louisiana State University) The ovariectomized retired female breeder rat as a model for postmenopausal women.

Poster Presentations

Adair, Matthew S. and P. Brent Nichols. (Mu Phi, Jacksonville State University) The ecological distribution of tardigrades on Dugger Mountain, Alabama.

Wallace, Memory M. (Mu Phi, Jacksonville State University) Oxygen consumption rates in neotenic Oklahoma salamanders, *Eurycea tynerensis* (Plethodontidae).

Author Index for Paper, Poster, and Abstract Number

Only first authors are indexed

- | | | |
|--------------------------------|------------------------------|-----------------------------|
| Adams, Eric D. - 166 | Castano, Diana F. - 124 | Faith, Sheila C. - 103 |
| Adams, Harold S. - 13 | Cheadle, Mark A. - 68 | Faulkner, Charles T. - 198 |
| Adams, Jason R. - 207 | Chou, Tien-Min - 200 | Fels, John E. - 88 |
| Aderman, Jennifer A. - 58 | Christy, Arthur M., Jr. - 30 | Fisher, Ginger R. - 120 |
| Aliff, John V. - 234 | Clebsch, Edward E.C. - 268 | Font, William F. - 150 |
| Alkaff, Huda F. - 20, 229 | Cline, George R. - 190 | Francko, D.A. - 54 |
| Allison, James R. - 237 | Close, David D. - 186 | Franklin, Scott B. - 189 |
| Anderson, Loran C. - 70 | Cocking, W. Dean - 270 | Gamble, Robert J. - 33 |
| Arnold, Amy E. - 170 | Coffer, Natalie J. - 194 | Gaugler, Michael S. - 126 |
| Baldwin, Andrew S. - 129 | Coggin, Steven J. - 83 | Glickauf, Steven - 167 |
| Barden, Lawrence S. - 188 | Collins, Beverly - 264 | Goleman, Wanda - 12 |
| Barnett, Jason - 84 | Collins, Christi - 42 | Gray, Margarit - 59 |
| Barnwell, Michael K. - 18, 114 | Collins, Kristy R. - 81 | Greenberg, Cathryn H. - 164 |
| Barr, Aaron D. - 154 | Conner, William H. - 38 | Greene, Stephen D. - 56 |
| Bart, Henry L., Jr. - 249 | Connors, Vincent A. - 201 | Gunn, Bob - 77 |
| Basinger, Mark A. - 168, 169 | Cook, Rebecca A. - 233 | Hackney, Courtney T. - 262 |
| Battaglia, Loretta L. - 163 | Cook, Susan B. - 37 | Hall Rutherford - 55 |
| Beard, Charles E. - 61 | Cooper, Aaron - 21 | Hamilton, Ashley K. - 225 |
| Bennetsen, Derek - 27 | Corbin, Jeffrey D. - 258 | Hamilton, Robert IV - 127 |
| Bennett, Chipley B. - 11 | Coulling, Philip P. - 192 | Hamzé, Samara I. - 175 |
| Benz, George W. - 146 | Crank, C. - 143 | Haney, Dennis C. - 254 |
| Blackston, Christie R. - 80 | Crock, Christopher J. - 173 | Harrell, Michael T. - 5 |
| Blackwell, Eric A. - 208 | Cruzan, Mitchell B. - 228 | Harrod, Jonathan - 98 |
| Blagburn, Byron L. - 195 | Cunningham, Maureen - 178 | Haynes, Robert R. - 76 |
| Bogitsh, B.J. - 65 | Dandridge, Keri L. - 26 | He, Tao - 73 |
| Bone, Samantha J. - 135 | Dateo, Dorothy M. - 112 | Heacock, Charles H. - 123 |
| Booth, Robert K. - 193 | Davis, J. Eric Jr. - 177 | Henry, Andrea L. - 57 |
| Brannon, M. Patrick - 110 | Dee, Jennie L. - 147 | Herr, J.M., Jr. - 130 |
| Bratton, Susan P. - 100 | Delcourt, Paul A. - 97 | Hill, Steven R. - 242 |
| Bray, Rebecca D. - 155 | Devivo, Joseph C. - 50 | Hood, Robert W. - 219 |
| Brittingham, Kevin D. - 220 | Dills, Melissa D. - 212 | Horn, Charles N. - 182 |
| Brooks, Janie S. - 106 | Dilustro, John J. - 41 | Hou, Yue - 64 |
| Buhlman, Kurt A. - 210 | DiMasi, M. Katie - 24 | Houser, Crystal C. - 238 |
| Bullard, Stephen A. - 148 | Dimock, Ronald V., Jr. - 14 | Hupp, Cliff R. - 223 |
| Burke, Ian C. - 156 | Dobson, William E. - 116 | Imm, Donald W. - 161 |
| Burse, Jeanine R. - 35 | Draney, Michael L. - 107 | Jhee, Edward M. - 137 |
| Busing, Richard T. - 99 | Drozda, Nicholas - 131 | Johnson, Margaret A. - 174 |
| Caira, J.N. - 3 | Durrant, Gary E. - 115 | Johnson, Shelley L. - 71 |
| Camlin, Amanda - 8 | Edwards, Lonnelle G. - 180 | Johnston, C.E. - 47 |
| Caplen, Cynthia A. - 157 | Egleston, D. Dubose - 227 | Jones, Dale B. - 250 |
| Carter, Robert E., Jr. - 191 | Emery, M. - 142 | Jones, Jody - 231 |
| | Evans, Dan K. - 243 | Jones, M. Tildon - 22 |
| | Fairey, John E. III - 179 | Jones, Robert M. - 196 |

- Kahn, Wendy - 19
 King, Anthony W. - 104
 Knauper, Beverly A. - 230
 Lapp, Kevin D. - 209
 Larson, D.W. - 269
 Levi, Jeff A. - 259
 Lickey, Adrienne - 4
 Lin, Tiffany S. - 176
 Lindsay, D.S. - 69
 Liu, Hong - 45
 Mammone, Karen A. - 111
 Marks, Susan - 15
 Marsh, Brian - 113
 Martin, William A. - 40
 Matter, John M. - 214
 Maurakis, Eugene G. - 46
 Mayne, Christopher D. - 222
 Mayo, Dobb - 25, 51
 McCallum, Jeffrey B. - 9
 McCarron, James K. - 260
 McCleneghan, S. Coleman - 158
 McCormick, Frank - 171
 McCoy, Roger A. - 187
 McDonald, Amanda A. - 263
 McElroy, Tom C. - 136
 McFadden-Wenig, Colleen - 60
 McGuire, Robert F. - 159
 McGuire, William R. - 246
 McHenry, Diana J. - 152
 McLeod, Kenneth W. - 261
 McReynolds, William M. - 52
 Meader, Lisa L. - 197
 Medland, Vicki L. - 218
 Meier, Albert J. - 87
 Menhinick, Edward F. - 48, 247
 Midkiff, Erica S. - 215
 Miller, Luitpold E. - 108
 Miller, Susan P. - 257
 Mills, Mark S. - 213
 Mitchell, Joseph C. - 206
 Mohamed, Fawzi - 199
 Morrow, Jessica L. - 211
 Morton, Wade - 17
 Moser, Mary L. - 10
 Murrell, Zack E. - 132
 Musselman, Lytton J. - 151
 Neely, David A. - 252
 Neils, David E. - 122
 Nelson, John B. - 75
 Newell, Claire L. - 91
 Noel, William - 239
 Norris, Amy R. - 226
 O'Brien, Jack J. - 2
 Onorato, Dave - 49
 Pack, Kari J. - 109
 Patterson, Karen D. - 93
 Patton, Sharon - 67
 Pauley, Thomas K. - 202
 Paxton, Barton J. - 205
 Pearson, Scott M. - 101
 Peet, Robert K. - 95
 Perrine, Gail L. - 118
 Petty, J. Todd - 251
 Piascik, Jennifer - 204
 Piller, Kyle R. - 248
 Pittillo, J. Dan - 86
 Pittman, Albert B. - 235, 236
 Pivorun, Edward B. - 79
 Pollard, A. Joseph - 138
 Powell, Allyn - 255
 Prentice, Erik - 63
 Rae, John G. - 183
 Reddy, Palla S. - 117
 Renne, Ian J. - 36
 Ritland, David B. - 105
 Roberts, Stephen D. - 94
 Robertson, Jennifer L. - 43
 Rogers, Jason - 253
 Rohde, Fred C. - 244
 Rollins, Sarah C. - 185
 Russell, Ann M. - 216
 Russell, Cameron L. - 153
 Sanders, Anna K. - 139
 Schmidt, John M. - 28
 Scholtens, Brian G. - 128
 Schotthoefer, Anna - 144
 Schwartz, F.J. - 256
 Scott, Jon B. - 140
 Seckinger, George W., Jr. - 241
 Sepulveda, Shannon R. - 23
 Sewalk, Chester - 29
 Sharp, Homer F. - 217
 Shew, H. Wayne - 16
 Shull, J. Kenneth - 85
 Small, Christine J. - 90
 Smith, Bradley E. - 119
 Soucek, David J. - 149
 Spratt, Henry G., Jr. - 82, 39
 Stalter, Richard - 240
 Stephenson, Steven L. - 184
 Stoll, Syam - 245
 Strange, Rex Meade - 53, 134
 Stratton, Lewis P. - 78
 Suchecki, Sharon R. - 162
 Swab, Janice C. - 232
 Tarleton, R.D. - 1
 Tarter, Donald C. - 125
 Taylor, David D. - 172
 Tuberville, Tracey D. - 165
 Tucker, R.B. - 141
 Tucker, Robert B. - 203
 Turrill, Nicole - 160
 Unwin, Matthew - 133
 Walker, Gary L. - 266
 Walker, Joan L. - 181
 Watson, Brian T. - 121
 Watson, Linda E. - 72
 Weaver, Warren T. - 224
 Weishampel, John F. - 31
 Wentworth, Thomas R. - 92
 Werth, Charles R. - 74
 White, Peggy L. - 6
 White, Peter S. - 96
 Wikle, R.E. - 62
 Wilds, Stephanie P. - 102
 Wilhelm, Eric S. - 66, 221
 Williams, Denise - 44
 Winstead, Joe E. - 265
 Wise, Dwayne - 7
 Wohl, Debra L. - 34
 Woodhead, Jennifer L. - 32
 Young, John M. - 267
 Zartman, Charles E. - 89
 Zelmer, Derek A. - 145

REVIEWS

Wagner, Warren L. and Vicki A. Funk, (eds.) 1995. Hawaiian Biogeography: Evolution on a hot spot archipelago. Smiths. Inst. Press, Washington, xvii + 467 pp. \$45.00 hardbound, \$25.00 paperback.

When I was a young graduate student I became all excited upon learning of the existence of the unusual Hawaiian silversword plants that grew only on the slopes of the extinct volcano Haleakala. It became a dream that I would one day be able to see the plants first hand. The dream became a reality in 1986 when I visited the islands and could not wait to travel to Haleakala. There I was able to discover the most beautiful of the silverswords, on my own, along the very rugged rim of the colorful crater. I still become very excited when I think of them and all the other unusual plants and animals that one can encounter in the unique realm of these isolated volcanic islands.

While this book makes no romantic reference to the silverswords, it is a modern attraction for the biologist. In the first place, of course, this is because it deals with the Hawaiian Islands, an unparalleled example of insular evolution. Its diverse habitats, ranging from very dry to the wettest on earth and from sea level to 4,200 m in elevation, with very sharp demarcations, are found on a continuous linear formation of islands that record a historical chronology. As the earth's crust passed over a hot spot under the mantle, a chain of volcanic islands formed that are fresh and new at the younger end and eroded to oblivion at the older end. In between are the stories of survival and adaptation as a mantle of life forms on the rocks and stays for a good long while. The plants and animals that make it to these isolated rocks show details of colonization, radiation, local migration, and even extinction that allow scientists to detect patterns of evolution like nowhere else on Earth. This book deals with recognizing and analyzing these patterns.

The second reason that this book is worthy of note is because it takes a selected view of how the data are explained. In the preface the authors state: "Indeed, this [book] may represent the first attempt to analyze a significant portion of the plants and animals of any natural area using a formal, rigorous approach, such that the results can be compared across different taxonomic groups. Each [chapter author] applied phylogenetic methods to morphological of molecular data to generate phylogenetic hypotheses, secondarily deriving biogeographical hypotheses. Rather than mere summaries of the participant's research, these studies mostly present new data and analyses. Each contributor has used consistent methodology Patterns generated in these studies have been further manipulated to test ideas about evolution, such as innovation in breeding systems, behaviors, or ecology in an insular environment."

This volume is the result of a 1992 symposium co-sponsored by the American Society of Plant Taxonomists and the Association for Tropical Biology. After an introductory chapter by veteran island researcher Sherwin Carlquist, important contributions follow on the geology and biogeography of the Hawaiian Islands and on cladistic methods. The 17th and final chapter is a summary of all the chapters in analyzing the biogeographic patterns in the Hawaiian islands and is by the editors of the volume. The intervening chapters deal with six animal and seven plant examples. These subjects include crickets, *Drosophila*, plant bugs, spiders, honeycreepers, *Tetramolopium*, *Schiedea*, *Alsiniidendron*, the silverswords, *Cyanea*, *Clermontia*, and *Scaevola*. There are a few black and white photographs, some well-done line drawings, numerous tables, several maps, and a good many cladograms throughout the text.

I found the volume to be well done and with more than the usual consistency. The numerous references cited are listed together in the back, and there is a detailed index including scientific names of organisms.

The individual studies are noteworthy in themselves, and the overall analysis makes this an even more valuable contribution. It would be rewarding reading to biologists everywhere who have even a shred of interest in the Hawaiian biota, and one could definitely glean lecture material for courses in evolution, numerical taxonomy, ecology, and biogeography. Some very recent studies are included and it is significant to have this contribution showing the application of modern cladistics to biological data. Even if you want to overlook the cladistics *per se*, there is ample traditional information on taxonomy and evolution. I would go so far as to say that this volume might even help you see how cladistics may be applicable even if you never thought so before.

T. LAWRENCE MELLICHAMP, *Biology Department, University of North Carolina at Charlotte, Charlotte, NC 28223.*

Klimley, A.P. and D. G. Ainley. Great White Sharks. The Biology of Carcharodon carcharias. Academic Press, NY. \$58.00. 567 p.

Silently in lonely splendor, the great white shark (*Carcharodon carcharias*), a fish of grace and power in action which fears no one, cruises the world's oceans, yet causes fear and awe in man. Klimley and Ainley's book contains 45 papers presented at the May, 1993 second meeting on the *white shark* (official American Fisheries society common name); the first meeting occurred in May, 1983. The book is authored by 67 scientists (30 from California) from nine countries and divided unevenly into eight parts: Introduction (2 papers), Evolution (6), Anatomy (2), Physiology (5), Behavior (8), Ecology and Distribution (9), Population Biology (6), and Interactions with Humans (7). Summary reviews occur at the ends of the Behavior, Population Biology, and Interaction with Human parts.

Even though there has been a great deal of research on the white shark, especially off the Pacific Coast of the United States, we still learn that information is lacking concerning its anatomy, physiology, length of gestation period, behavior reaction to objects, and the meaning of splashing and size of splash. Better tags and tagging methods will permit us to go from descriptive to experimental approaches in order to resolve how the sharks get to Europe and/or whether an individual remains or rapidly exits an area following tagging or an attack on man or prey. What are the white shark's population parameters and estimates, is the bite and release the real behavior of a feeding white shark and why, and what makes them attack one object, but not another? These and a host of other questions have been raised by the researchers suggestion the researchers' appetites have only been whetted for more.

We learn, however, that most attacks occur in shallow depths during daylight hours. Eighty attacks (to 1994) have been recorded for the US Pacific coast *versus* six in the Atlantic. White sharks seem to prefer black/yellow, black/white, blue/orange colored objects. Seals and elephant seals are its preferred foods in the Pacific, while shales and some seals are foods in the Atlantic.

As expected, information concerning the white shark's mating and physiology is badly needed, but is lacking because its large size precludes its being kept in aquaria. Perhaps the Monterey aquarium will consider the white shark a prime candidate for its large ocean tank display. However, sharks rarely behave "normally" (even feed) while in captivity.

Many papers relate the problems the researchers had because they did not know the size of the population being studied, what the sex ratio was in an experimental area, or whether the attacks were by a lone individual that stayed or immediately left the area following an attack. New light, however, has been gleaned in that embryos are oophagous, while the adults exhibit vivipary. Fossils also helped(?) resolve the evolutionary history of the white shark, yet the

phylogenetic analysis of the family Lamnidae still remains unresolved. White sharks are now protected in California and South Africa.

The only aspect that I found tedious was that the bibliographies of all the papers were consolidated onto one large list on pages 493-513 at the end of the book. While this may have saved a few pages, one had to constantly flip back and forth past several hundred pages to check on a reference of interest. A three-page index completed the volume.

Unfortunately for us, white sharks seem to be decreasing in number worldwide. Perhaps we will be spared from attack because we may not taste good or are not as fat as sea lions or seals, their preferred foods. But what will happen as we protect them, will they increase as are the seal populations? Tune in 10 years hence, the answers may be forthcoming then.

FRANK J. SCHWARTZ, *Institute of Marine Science, University of North Carolina, Morehead City, NC 28557.*

NEWS OF BIOLOGY IN THE SOUTHEAST

Jon R. Fortman-News Editor
 Division of Science and Math
 Mississippi University for Women
 Columbus, MS 39701

ABOUT PEOPLE AND PLACES

GEORGIA

Savannah River Ecology Laboratory, The University of Georgia. Local students, SRS senior management and environmentalists honored *Ruth Patrick*, Ph.D., an environmental science pioneer associated with the Savannah River Site. The U.S. Dept. of Energy named a wetland near the conference center after Dr. Patrick. At 89, she is retiring from the SRS Environmental Advisory Committee to complete work on five books. She is presently chairwoman of the Limnology Department at the *Academy of Natural Sciences of Philadelphia* and for more than 35 years taught botany and limnology at the *University of Pennsylvania*. Researchers along with hundreds of Georgia public school students are using the internet to track the movements of four endangered wood storks outfitted in August with satellite transmitters. They are eager to see if the storks will overwinter where they were captured and released in the Harris Neck National Wildlife Refuge near Savannah, Ga., or whether they will head south to Florida's warmer climate, but less plentiful habitat.

ILLINOIS

Southern Illinois University at Carbondale, Plant Biology Department. Scott Franklin returned from a Fulbright in Finland where he received a Ph.D. in ecology. He is now a Temporary Instructor in the department and is currently teaching a course in ecological methods.

KENTUCKY

Western Kentucky University, Department of Biology. New faculty include: *Dr. Jeff Jack*, invertebrate zoology and aquatic ecology; *Dr. Sigrid Jacobshagen*, plant physiology, regulation and gene expression by biological clocks; *Dr. Mike Stokes*, vertebrate population and community ecology, computer applications in biology; *Dr. Ken Crawford*, comparative animal physiology, physiological ecology of reptiles; and *Dr. Kinchel Doerner*, ecology and physiology of ruminant and intestinal microorganisms. *Dr. Blaine Ferrell* has been appointed department head. His area of expertise is neuroendocrine mechanisms regulating expression of circadian rhythms in animals.

MISSISSIPPI

Mississippi State University, Department of Biological Sciences. *Dr. Evan Weiher*, a plant ecologist, joined the faculty this past August. His area of research is plant community ecology and assembly rules. *Dr. Jerome A. Jackson* is being named a Fellow of the American Association for the Advancement of Science and will be presented with a certificate and rosette at the February 1997 meeting in Seattle.

University of Mississippi, Department of Biology. *Dr. Marjorie Holland* (Ph.D., *University of Massachusetts*) joined the department as Director of the University of Mississippi Biological Field Station. *Dr. Holland* was previously employed as a Senior Research Ecologist at EPA. *Dr. Stephen Brewer, Jr.* (Ph.D., *Louisiana State University*) joined the department after finishing a postdoctoral appointment at *Brown University*. He is a plant ecologist working on the effects of disturbance on plant community structure. *Dr. Gary L. Miller* assumed the position of Acting Chair of the Department in June 1995.

NORTH CAROLINA

East Carolina University, Department of Biology. *Dr. W. James Smith* was cited for 30 years of service to the department. *Dr. Roger Rulifson* received a \$36,940 grant from NC Dept. of Environmental Health and Natural Resources for his research on the Life History Aspects of Hickory Shad, *Alosa mediocris* in the Albermarle Sound/Roanoke River Watershed. *Dr. Claudia Jolls* received a \$2,800 Michigan Dept. of Natural Resources grant for research on two endemic dune plants, *Cirsium pitcheri* and *Tanacetum huronense*. *Dr. Mark Brinson* with *Dr. Robert Christian* both received University of Virginia \$10,000 grants for Long-term Ecological Collaboration research at the Virginia coast Reserve. *Dr. Susan McDaniel* was one of twenty-four college/university faculty members across the nation, recognized by the National Academic Advising Association as a recipient of the 1996 Outstanding Adviser Certificate of Merit Awards. *Dr. Christine Wilton Helms*, (retired Biology) and her husband have a pair of gardens (Butterfly and Herb gardens) dedicated by the Greenville Garden club at River Park North, in Greenville, NC in their honor. *Drs. Terry West* and *Lisa Clough* received a \$44,790 NOAA grant for their research "A Tale of Two environments; Is it Always the Best of Times in Natural Systems and the Worst of Times in Mitigated Systems?"

Chowan College, Science Department. Beginning the Fall of 1996, a new Environmental Biology major (B.S. in Biology) will be offered within the Department of Science. Chowan's unique location in northeastern North Carolina allows for easy access to numerous aquatic habitats: the Meherrin and Chowan Rivers, the Dismal Swamp, Currituck and Albemarle Sound

as well as estuarine and coastal environments along the Outer Banks of North Carolina. By studying these environments from shore or on board Chowan's new research vessel, students will gain "hands-on" field experience, as well as classroom exposure to dealing with current environmental issues. Internships with local industries and environmental laboratories are available for students during their senior year.

North Carolina State University, Department of Botany. Dr. Eric Davies took over the department head position two years ago from Ernie Seneca. Niki Robertson joined the faculty to teach courses in biotechnology and play a major role in the College Honors Program. She has also developed a research program on gemini viruses and DNA replication. Nina Allen was hired to run the new Cell and Molecular Imaging Facility and brought with her equipment from Wake Forest. She and Wendy Boss have been instrumental in getting an additional \$600,000 in grants, so that another \$100,000 worth of imaging equipment can be purchased. A NASA grant of \$5,000,000 over 5 years will support a number of PIs, post-docs, graduate students and undergraduates. JoAnn Burkholder discovery of *Pfiesteria piscida*, the toxic dinoflagellate or "the cell from Hell", and her ongoing investigations into its role in fish kills has excited the imagination of the local and national media, and brought concern to those involved in environmental protection. The department is also looking for a plant systematist with strong research interests as a replacement for Jim Hardin.

TENNESSEE

The University of Tennessee, Knoxville, Department of Botany. Susan Farmer, a graduate student working with Dr. Edward E. Schilling, has recently been inducted into Phi Kappa Phi. Dr. Mark Camara from the University of Colorado at Boulder will be associated with the laboratory of Dr. Massimo Pigliucci for two years beginning November 1996. Dr. Camara will be on an NSF postdoctoral fellowship to study genetic constraints in *Arabidopsis* by means of selection-mutation experiments. Dr. Alan S. Heilman was awarded first prize in the 1996 Natural World Photographic Competition for his entry of "Sunflower." The competition in nature photography is supported by the Mudge Environmental Education Program of the Carnegie Museum of Natural History in Pittsburgh, PA. Dr. Otto J. Schwarz, a plant physiologist, was promoted to the academic rank of Professor. His research efforts continue to be focused on understanding the mechanisms of control of plant cellular differentiation, in particular the initiation of adventitious rooting in woody plants. He will shortly receive his first U.S. patent for the stimulation of adventitious rooting in conifers and flowering woody plants by a bacterium. Dr. David K. Smith has received the Raymond W. Holton Faculty Teaching Award for 1995-96. He was recognized for his excellence in teaching students for over twenty years. Dr. James D. Caponetti has received a Faculty Advising Service Award for 1995-96. He was recognized for his excellence in advising Pre-Health Professions students, and Botany and Biology majors for over thirty years.

MUSEUMS AND BOTANICAL GARDENS

ALABAMA

Anniston Museum of Natural History. The Alabama Historical Commission recently awarded \$5,000 to the Native American Cultural Center Project of the Museum. On November 22, *Kathryn Braund* explored the exciting world of early Alabama in William Bartram and Alabama: Human History and Natural History.

FLORIDA

Marie Selby Botanical Gardens, Sarasota. The book, *Forest Canopies*, published by Academic Press and edited by *Meg Lowman* and *Nalini Nadkarni*, has been reprinted in paperback edition. Featuring color photographs and extensive chapters on all aspects of natural history of forest canopies, this volume is a wonderful addition to the library of any nature-lover. It is available in the Book Shop at Selby Gardens. Another book by *Stephen Ingram*, *Karen Ferrell-Ingram* and *Nalini Nadkarni* entitled, *Epiphytes of the Monteverde Cloud Forest Preserve* is also available at the Book Shop. It includes an introduction, glossary, suggested reading list, including the orchids, followed by a list of species found at Monteverde in Costa Rica. An International Conference on orchid conservation will be held at the Botanical Gardens on June 5-8, 1997. The conference will include two days of speakers and panel discussions by some of the world's leading experts on orchid conservation methods, issue and regulations, and innovative "grassroots" projects. Space is limited to 300. For more information call 941-366-5731, Ext. 10 or Fax 941-366-9807.

ABSTRACTS

- 1 Tarleton, R.D. Department of Cellular Biology, University of Georgia, Athens, GA. - Chagas' Disease. Autoimmune or Parasite Inflammatory Disease?

The etiology of Chagas' disease has been the focus of much investigation and controversy. The slow increase in disease severity in the apparent absence of significant numbers of parasites in the target organs is the major justification for classifying Chagas' disease as an autoimmune disorder. An autoimmune etiology accounts for many of the characteristics of the disease state, including the spectral nature of the disease, the organ specificity, the age-related onset, and the presence of anti-self immune responses. Discovery and characterization of putative autoantigens which share epitopes with parasite molecules has strengthened the autoimmune hypothesis. However, despite the data demonstrating the presence of anti-self responses in *T. cruzi* infection, there has been no firm link established between these autoreactivities and the severity of disease in infected hosts or the induction of disease in non-infected hosts.

This talk will focus on recent investigations which fail to support autoimmunity as a primary factor in the development of Chagas' disease. These data include the exacerbation of disease in mice receiving immunosuppressive treatments, the association of inflammatory disease with the presence of parasites in lesion sites, and the failure of chronically infected mice to demonstrate autoreactivity to transplanted heart tissues. These studies provide theoretical support for efforts to reduce parasite load in patients as a means of minimizing disease severity. Similarly, the development and use of better anti-parasite chemotherapies in treating chronic and acute cases of *T. cruzi* infection may now be considered in a more favorable light.

- 2 O'BRIEN, JACK J. Department of Biological Sciences, University of South Alabama, Mobile, AL - What's So Special About Parasitic Castration?

Symbiotic associations such as parasitization of mollusks by the sporocyst and redial stages of digene trematodes, crabs by rhizocephalan barnacles, and insects by mermithid nematodes or strepsipterans have one characteristic in common: hosts do not reproduce. This phenomenon is known as **parasitic castration**. Although physiologically alive, hosts of parasitic castrators are reproductively dead. Unlike predation which can reduce intraspecific competition, parasitic castration may be a **fate worse than death** for the population of hosts because parasitized hosts often compete with unparasitized individuals for food and space while contributing nothing to the next generation. Furthermore, since the taxon, *species*, is restricted to individuals of a population capable of interbreeding, one could argue that once a host has been castrated by a parasite, it becomes a different species. An individual *Biomphalaria* that is shedding *Schistosoma* cercariae may look, move, and feed like a snail, but in a reproductive sense it is a flatworm. Parasitic castration creates situations wherein two genotypes (that of the host and that of the parasitic castrator) have the phenotype (that of the host). These symbiotic associations have the potential to provide new insight into the interplay of growth, size, and timing of reproduction in tests of ecological and evolutionary theories.

- 3 CAIRA, J.N. Department of Ecology and Evolutionary Biology, University of Connecticut, Storrs, CT 06269-3043 - Evolution and site specificity in the tapeworms parasitizing elasmobranchs.

Present estimates indicate that there are approximately 850 species of sharks, skates, and rays (elasmobranchs) inhabiting the oceans of the world today. To date, tapeworms have been found in all of the > 300 elasmobranch species examined for parasites. All of these tapeworms live as adults in the spiral intestine of their hosts. They represent, without contest, the most diverse group of internal parasites of elasmobranchs. Most elasmobranch species host 4 to 12 distinct tapeworm species. These tapeworms are extremely host specific. In many cases, each tapeworm species parasitizes only a single host species. Research on the Onchobothriidae, one of the most speciose families of elasmobranch tapeworms, suggests it is fairly common for congeneric tapeworm species to inhabit the same host species. Somewhat surprising, in such cases, these species are not each other's closest relatives; rather, they are more closely related to species inhabiting related host species. Each tapeworm species exhibits at least some degree of site specificity within the spiral intestine, conicospiral or scroll type, of its host. In some cases, this site specificity seems to be based on the close relationship between the morphology of the attachment organ (scolex) and the configuration of the mucosal surface at the site of attachment in the gut. However, in other cases, this relationship does not exist and thus site specificity is likely to be the result of some other factor. There is a clear historical component to site specificity because related taxa attach in similar sites within related hosts. Thus, both host associations and site of attachment can be predicted for many species of elasmobranchs not yet examined for parasites.

- 4 LICKEY, ADRIENNE AND WILLIAM E. DOBSON. Biology Dept., Appalachian State University, Boone, NC 28608-Effects of environmental factors on ossicle banding patterns in *Amphiopholis gracillima*.

The age of members of a population is often determined using body size class distributions. This method works well in populations where there are constant measurable physical characteristics. However, this is not the case with *Amphiopholis gracillima*, an amphipod ophiuroid which has the ability to autotomize and subsequently regenerate both its arms and central disc. Depending on the stage of regeneration, the diameter of the central disc will vary, as will the length and width of the arms. Another characteristic that can be measured is the number of bands that occur in a pattern on the fossil surfaces of their vertebral ossicles. Previous studies have indicated that regenerating and control *Amphiopholis gracillima* will develop between zero and six of these bands per year, with a median ring count of two bands per year. This study looked at three different environmental stress factors -- salinity, temperature, and nutrient availability -- to see if they contributed to the variation found in the banding patterns. Preliminary results indicate that increases in band number are not seasonal, but instead are phenomena that result from a combination of body growth patterns and environmental stressors.

- 5 HARRELL, MICHAEL T. AND ANNA M. HILL. Department of Biology, Northeast Louisiana University, Monroe, LA 71209 - Will vitamin enriched diets enhance growth of hatchling alligator snapping turtles (*Macrochelys temminckii*)?

The alligator snapping turtle (*Macrochelys temminckii*) is a protected species in much of its range and is a candidate for protection in Louisiana. Sexual maturity is determined by turtle size not age; therefore, faster growth means less time to maturity. Three groups of hatchling alligator snapping turtles were fed different diets to test for effects on growth. Diets were fish only (F); fish and ReptoMin, a food supplement (FR); fish, ReptoMin and Nekton, a vitamin supplement (FRN). In one year FR and FRN hatchling growth (both about 675%) exceeded F hatchling growth (298%). Results suggest that supplemented diets for hatchlings may ultimately, by increasing growth rates, shorten time to maturity and increase reproductive success.

- 6 WHITE, PEGGY L. and M. CATHARINE COX. Wingate University -- The effects of estradiol-17 β on the development of the clitero-penis in the American alligator, *Alligator mississippiensis*

Incubating alligator eggs were treated with various concentrations of estradiol-17 β in order to determine the biological effects of this hormone on sexual differentiation. Administration of estradiol-17 β to embryos incubated at male determining temperatures results in female hatchlings supporting the hypothesis that estradiol-17 β can counteract the effects of temperature in sex determination. The purpose of this study was to determine normal developmental patterns associated with the clitero-penis of embryos incubated at both male and female temperatures as well as the effects of estradiol-17 β on these normal patterns. Ten days after hatching, the alligators were euthanized, and the clitero-penis was removed. The tissue was fixed in Bouin's solution, washed in alcohol, embedded in paraffin blocks, sectioned, and stained. Next, immunocytochemical techniques were used to localize insulin-like growth factor-I, epidermal growth factor, and fibroblast growth factor in order to determine if estradiol-17 β exposure alters the normal distribution of growth factors in the clitero-penis. Results of the study demonstrate that administration of estradiol-17 β disrupts the normal development of the clitero-penis in the male hatchling as well as the immunocytochemical staining patterns for the three growth factors.

- 7 WISE, DWAYNE, HOLLY KUPFER and NATALE TATE. Mississippi State University - The ultrastructure of sex chromosome association during meiosis in spider spermatocytes.

Male spiders of all species that have been examined cytologically have the sex chromosome constitution, $n(X_1X_2)$. Females have X_1X_1 , X_2X_2 , etc, and these pair at zygotene and form ordinary chiasmate bivalents. The multiple X's of males are not homologous and appear not to be physically connected at metaphase I. We have examined at the ultrastructural level the behavior of the non-homologous X's in certain species of lycosid spiders. All individuals examined have the X_1X_2 sex chromosome constitution. The X chromosomes are associated throughout meiotic prophase by a synaptonemal complex-like structure, the "junction lamina".

In silver-stained spread preparations, the two X's are associated at their kinetochore ends, each axial core is visible, but no structure resembling the synaptonemal complex is found. Even so, the junction lamina appears to be sufficient to join the two X's such that they orient to and migrate to the same spindle pole at anaphase I, thus ensuring the 1:1 male:female sex ratio.

8 CAMLIN, AMANDA AND G.R. DAVIS. Wofford College - Developmental changes in myelin in the spinal cord of the bullfrog (*Rana catesbeiana*).

The purpose of this study was to examine developmental changes in myelination within the spinal cord. One of two histological stains for myelin (Chromoxane cyanine R and Lapham's) was applied to cross sections of the brachial spinal cord from two adult bullfrogs and two larvae each at Stage IV, VII, and X. Four observers made estimates of staining intensity and distribution within each of 3 funiculi: dorsal (DF), lateral (LF), and ventral (VF). Similar results were obtained with the two stains. The intensity of myelin staining was similar at each larval stage although DF and VF consistently stained darker than LF. In adults, staining was more intense in each funiculus, and myelin staining in LF was considerably darker than in larvae. In larvae, 60-90% of the area in DF and VF was stained but only about 50% of the area in LF was stained. In adults, myelin staining encompassed 90-100% of each of the three funiculi. These results demonstrate marked differences in the intensity and distribution of myelin staining in larval and adult bullfrogs. The observations are consistent with the notion that propriospinal axons of the lateral funiculus (which coordinate limb movements) arise and/or are myelinated late in development.

9 MCCALLUM, JEFFREY B. AND EDMUND J. STELLWAG. Department of Biology, East Carolina University, Greenville, N.C. 27858 - DNA sequence analysis of a putative HoxB2 containing genomic clone from the teleost, *Morone saxatilis*.

A 7,900 bp region from a *Morone saxatilis* (striped bass) λ EMBL-3 genomic clone that hybridized strongly to a PCR-based homeobox-specific probe was sequenced using primer walking. Analysis of the striped bass DNA sequence revealed a homeobox with 84% sequence homology to the HoxB2 homeoboxes in humans and mice. In addition to the homeobox, the DNA sequence analysis provided presumptive support for the existence of 2 exons within the 7,900 bp fragment. The first exon shows a 90% DNA sequence homology with the first exon of HoxB2 in humans. The second exon encodes the homeobox. Overall, these results suggest that the λ genomic clone encodes the entire HoxB2 transcription unit including a 2550 bp region upstream of the transcription start signal containing the promoter, two exons, one intron, and a region extending 2500 bp beyond the transcription termination signal.

10 MOSER, MARY L., FRED C. ROHDE, AND RUDOLF G. ARNDT. University of North Carolina-Wilmington Center for Marine Science Research, North Carolina Division of Marine Fisheries, and the Richard Stockton College of New Jersey - Distribution of the brook silverside, *Labidesthes sicculus*, in North Carolina.

The brook silverside, *Labidesthes sicculus* (Cope), occurs in the St. Lawrence River drainage and southern Great Lakes tributaries, the Mississippi River basin, and Atlantic and Gulf drainages from the Santee River in South Carolina to the Sabine River in Texas. Reported occurrences closest to the state of North Carolina are from eastern Tennessee, in the Little Tennessee River drainage, and from eastern South Carolina, in the Santee River drainage. The brook silverside has never been reported from Atlantic slope drainages north of the Santee River. We collected 35 specimens at 5 sites in the Waccamaw River drainage in North and South Carolina and 26 specimens at 5 sites in the Lynches River, South Carolina. We also report on the collection of five specimens from the Lumber River in North Carolina. Extensive sampling from 1961-1992 in the Waccamaw River drainage failed to collect this species. Therefore, we propose that the brook silverside has expanded its range northward on the Atlantic slope.

11 BENNETT, CHIPLEY B. AND THOMAS MCINNIS. Clemson University - Assessment of drought tolerance in endophyte-infected tall fescue

Acremonium coenophialum Morgan-Jones and Gams is a fungal endophyte of tall fescue grass (*Festuca arundinacea* Schreb.). Although implicated in livestock poisoning in the southeastern United States due to

fungal production of toxic ergot alkaloids in infected foliage, endophyte-infected plants (EI) also exhibit several beneficial agronomic traits absent in the fungus-free plants (EF), especially drought hardiness. We have determined that EI has reduced water loss, higher leaf water potential (Ψ), higher leaf osmotic potential (S), higher leaf turgor pressure (P), and slower onset of drought-induced dormancy compared to equally stressed EF. Since the primary mechanism for plant control of water loss is mediated through the plant hormone abscisic acid (ABA), our experimentation centered on this phytohormone. ABA levels (HPLC/GC-MS) were elevated in EI compared to EF under drought stress with ABA detectable much earlier. These data suggested ABA involvement in EI drought tolerance. Although fungal augmentation of plant-produced ABA appeared plausible, extensive experimentation with fungal broth cultures failed to yield detectable amounts (>2.5 ng/ml). Experiments with the C-40 ABA pathway inhibitor, fluridone, were designed to determine if fungal-produced (C-15) ABA was contingent upon some plant product. Preliminary results have shown a marked reduction in ABA levels in water-stressed EI and EF plants, suggesting the fungus is not directly contributing to the elevated ABA levels detected in the EI plants. Research supported by the Cooperative State Research Service, U. S. Department of Agriculture, under agreement No. 94-37106-1062.

- 12 GOLEMAN, WANDA, KIM MARIE TOLSON, AND JANIS GULICK. Department of Biology and School of Pharmacy, Northeast Louisiana University, Monroe, LA 71209-0520 - Characterization of hematopoietic cells in the bone marrow of the nine-banded armadillo.

Although the nine-banded armadillo (*Dasypus novemcinctus*) has been used in medical research for over two decades, much remains unknown about their hematopoietic processes. Bone marrow biopsies were performed on the proximal end of the right tibia of thirty-seven armadillos using a sternal Jamshidi needle (Baxter). Differential counts to characterize the hematopoietic cell lines of marrow were obtained from Wright-stained slides. Automated electronic and manual differential cell counts were performed on peripheral blood drawn from the right subclavian vein for comparison. The morphology and relative abundance of both marrow and peripheral cells were similar to those found in humans. As predicted, myeloid cells were the predominant cell type observed. Additionally, slides made by rolling a marrow core biopsy were found to be superior to those produced from marrow aspirates. This project was funded in part by a Summer Research Fellowship awarded by the Northeast Louisiana University College of Graduate Studies and Research.

- 13 ADAMS, HAROLD S.¹, STEVEN L. STEPHENSON², AND STEWART A. WARE³. ¹Div. of Arts and Sciences, Dabney S. Lancaster Community College, Clifton Forge, VA 24422, ²Dept. of Biology, Fairmont State College, Fairmont, WV 26554, and ³Dept. of Biology, College of William and Mary, Williamsburg, VA 23187. - Mid-Atlantic forests with a beech component.

Quantitative data on topographic variables and composition and structure of the tree stratum (stems ≥ 10 cm DBH) were collected from a total of fifty forest stands with American beech (*Fagus grandifolia*) present as a significant (IV ≥ 17.5) component. Sampled stands were located in western Virginia (Giles County), West Virginia (Cranberry Glades and the Fernow Experimental Forest and adjacent portions of the Otter Creek Wilderness Area), southwestern Virginia (Mount Rogers and White Top Mountain), eastern Virginia, and the western portion of the Great Smoky Mountains (GSM). Forty-eight species of trees were tallied in the fifty stands. Basal area of trees (m^2/ha) in the sampled stands ranged from 16.3 to 58.2, and density of trees (stems/ha) ranged from 198 to 1,820. DECORANA ordination of the fifty stands resulted in an X-axis with GSM stands at one end and eastern Virginia stands at the opposite end. Southwestern Virginia stands clustered close to those from the GSM, whereas most West Virginia stands and western Virginia stands were located close together near the center of the ordination. As such, the lines of compositional separation would seem to parallel those of the distributional limits of the three population types of beech, with gray beech in the GSM and southwestern Virginia, red beech in West Virginia and western Virginia, and white beech in eastern Virginia.

- 14 DIMOCK, RONALD V., JR. and RANDALL W. STRUBE. Wake Forest University-Unionid mussels release glochidia larvae in response to exogenous serotonin.

Physiological control of the release of glochidia by unionid mussels is not well understood. Selected molluscan neurotransmitters have been shown to induce release of gametes by marine bivalves and the zebra mussel *Dreissena*. We have explored the effects of exogenous serotonin, acetylcholine and dopamine on gravid unionid mussels, primarily the anodontines *Uterbackia imbecillis* and *Pyganodon cataracta*. Glochidia release was monitored by video, including endoscopy within the suprabranchial chamber. At 10^{-5} M, 5-HT induced release via the exhalant siphon within 20-40 min. Release was preceded and accompanied by rhythmic valve adductions at approximately 0.75 adductions/min. Glochidia emerged in a continuous mucus-bound stream from *Uterbackia*, but were often expelled more nearly in 'puffs' by

forceful valve adductions in *Pyganodon*. Neither acetylcholine nor dopamine stimulated glochidial release. Preliminary experiments indicated no effect of 5-HT on *Lampsilis hydiana*, but at 10^{-5} M it resulted in rapid expulsion out the exhalant siphon of a single conglutinate by *Villosa lienosa*. The data suggest that exogenous 5-HT, and perhaps other pharmacologic agents, may be an effective non-invasive technique to acquire glochidia without undue mechanical trauma to parental mussels. It may be possible to adapt this approach for acquiring glochidia to threatened or endangered unionid species for *in vitro* culturing programs as part of conservation efforts.

- 15 MARKS, SUSAN. Department of Biology, Winthrop University, Rock Hill, SC 29733 -Effects of nutrient availability on competitive ability of tall fescue infected with a fungal endophyte.

Many studies have shown that the presence of *Acremonium coenophialum* has a beneficial effect on the growth and competitive abilities of *Festuca arundinacea* (tall fescue). However, other studies have shown that the beneficial growth response of tall fescue appears to depend on the resources available to the symbiotic pair. This study examined the competitive interactions between infected and non-infected tall fescue plants under low and high nutrient resource availability in a greenhouse study. There was a significant response of plant growth to infection, nutrient availability, and the interaction between the two. Infected plants grown with non-infected plants (IN) were 61% larger than the non-infected plants with which they were grown (NI) while infected plants grown with other infected plants (II) were only 24% larger than non-infected plants grown with non-infected plants (NN). Under low nutrient conditions, there was no significant difference in size between the NI and IN plants, or between the II and NN plants. This study was repeated at a different time of year, and, although the results varied, again there was a significant interaction between nutrient availability and plant growth under competitive conditions. This study indicates that competitive interactions between infected and non-infected tall fescue plants can be dependent on the abiotic environment.

- 16 SHEW, H. WAYNE. Birmingham-Southern College, Birmingham, AL - Cytogenetics of *Cakile*: Preliminary Observations.

All the species of *Cakile* are succulent, branched, herbaceous annuals or fortuitous perennials. All but one species are strand plants that grow along oceans, large seas, or the Great Lakes of North America. One species is endemic to desert regions around the Persian Gulf but does not occur on the shores of the Gulf. The genus is a member of the Brassicaceae family and is of particular interest because of its ability to grow equally well in both saline and freshwater environments. Therefore, it may serve as a model plant for investigations of stress tolerance in plants. The plant is easy to grow in tissue culture, and is also readily micropropagated and grown as plants in culture vessels. Although chromosome numbers have been determined for species of this genus no one has done a systematic cytogenetic study for any of the species. The present study involves construction of a preliminary karyotype for two of the species, *Cakile edentula* and *C. constricta*. The procedures involved collection of root tips from germinated seeds, pretreatment with 8-hydroxyquinoline, fixation in Farmer's Fixative, and chromosome staining with Feulgen. Additional staining procedures to obtain banding patterns for the chromosomes are under way and will be used to provide a more detailed karyotype for each of the species.

- 17 MORTON, WADE and EDWARD MILLS. Wingate University--Niche overlap and resource partitioning among five turtle species in Lake Wingate, NC

Lake Wingate is a 12 acre eutrophic, monomictic lake that supports populations of five turtle species. Mark-recapture data from 163 captures predict populations of 230 Painted Turtles, 96 Yellow-bellied Sliders, 15 Common Snapping Turtles, and smaller groups of Eastern Mud and Common Musk Turtles, for a community of about 400 turtles. Analysis of several niche components demonstrate that the closely related Painted Turtles and Yellow-bellied Sliders have measurable differences in the characteristics and locations of basking sites, different activity (including foraging) patterns, and chose different bait combinations. Basking strategies and activity patterns of Sliders and Snappers changed as they took advantage of the warming epilimnion during summer. Niche measures show little overlap, at least for these dimensions of the Painted and Slider turtle niches. Limited data for the other turtle species also point toward similar resource partitioning. Maximum Secchi readings of 0.5 meters reflect the dark staining of the water that restricts growth of benthic macrophytes; this decreases the sizes of the potential foraging areas for herbivorous turtles.

- 18 BARNWELL, MICHAEL K., GARY DURRANT, KENNETH PILGREEN, GEORGE CLINE. Dept. of Biology, Jacksonville State University - Anatomical description of "Henson's cartilage" located between the vomer, maxilla, and premaxilla in the skull of bottlenose dolphins, *Tursiops truncatus*.

The bottlenose dolphin skull, unlike terrestrial mammals, has an expanded skull, in which the vomer, maxilla, premaxilla, and palatine bones are extended to form the rostrum of the dolphin. It is also known that dolphins have sinuses dorsal to the frontal bone. Using Magnetic Resonance Imaging (MRI), we discovered an area in the dolphin skull that was presumably bone forming parts of the vomer, maxilla, and premaxilla. Instead this tissue has a different density than the bones in the area. This tissue was found in both adult and neonate dolphin that were obtained from the Alabama Marine Mammal Stranding Network. Using gross dissection and histological methods, the tissue was identified as a cartilage that extends from the rostral tip to the frontal bone. This cartilage may be acting as a space filler in dolphins for diving or could be functioning in echolocation.

- 19 KAHN, WENDY AND R.G. WETZEL. Department of Biological Sciences, University of Alabama, Tuscaloosa, AL 35487-0206 - Effects of UV irradiance and microscale water level fluctuations on periphytic microbiota.

Effects of alterations of UV-A (320-400 nm) and UV-B (285-320 nm) irradiance were examined experimentally on the coupled metabolism of periphytic algae, cyanobacteria, and heterotrophic bacteria and their extracellular mucopolysaccharide (EPS) matrix. Attached communities were grown on glass fiber filters under controlled conditions of natural and UV-attenuated or augmented light in both a natural wetland (Talladega Wetland Ecosystem, Hale Co., AL) or in synthetic lakewater media under controlled laboratory conditions. UV-B had no significant effect on in situ pigment development ($p > 0.05$; ANOVA). Growth of bacterial communities was only slightly altered by selective removal of UV-A and UV-B but algal and bacterial productivity decreased greatly upon exposure to natural UV-B ($p < 0.05$). SEM analyses indicated decreased matrix development upon exposure to UV. Natural algal and bacterial communities developed under controlled PAR irradiance (400-700 nm) exhibited a marked decrease in biomass and productivity ($p < 0.05$) with either increasing UV intensities, decreasing wavelength spectra, or decreasing concentrations of UV-attenuating dissolved organic matter. Small changes in water level (1-10 mm), common on a diurnal basis in shallow wetlands, can result in large changes in UV-A and UV-B environments for the microbiota and result in rapid changes in microbial metabolism.

- 20 ALKAFF, HUDA F. Institute of Ecology, The University of Georgia, Athens, GA 30602 - Sea-level rise and coastal wetlands: The Sapelo Island Complex, GA

Coastal wetlands provide numerous ecological functions and protect urban areas from saltwater intrusion and storm surge. Because these areas occur at the land-sea interface they are strongly influenced by changing sea-level. Hence, it is of interest to characterize the effects of sea-level rise anticipated to accompany global climate change in the next century. I used a geographic information system (GIS) to define the impacts of sea-level rise on coastal wetlands. This study presents a quantitative analysis of both perimeter and interior wetland loss and/or gain of the Sapelo Island complex, during the period from 1920 to 1993, due to sea-level rise, river deposition and land erosion. Preliminary results indicate significant perimeter and interior changes (loss and/or gain) in the coastal wetlands of the Sapelo Island complex. This study is a prerequisite for the quantification and prediction of responses of coastal wetlands to sea-level rise.

- 21 COOPER, AARON AND G.R. DAVIS. Wofford College - Localized injection of neurotransmitters into the brainstem evokes locomotor activity in the isolated central nervous system of bullfrog larvae (*Rana catesbeiana*).

Stimulation of "locomotor initiation regions" in the brainstem of fish, reptiles, birds, and mammals can result in swimming, flying, or walking. The purpose of this research was to determine whether such regions exist in the brainstem of bullfrog tadpoles. The central nervous system was removed from bullfrog larvae and maintained at 4-16°C in oxygenated Ringer's solution. Locomotor activity occurred spontaneously and consisted of alternating bursts of electrical activity recorded from ventral roots (which innervate axial swimming muscles on either side of the body.) After spontaneous activity was suppressed by adding Mg^{++} to the Ringer's solution, glutamate and aspartate (natural neurotransmitters dissolved in Ringer's solution) were pressure-ejected through a fine glass pipette into circumscribed regions of the brain. When injected with

neurotransmitters, several brainstem regions reliably produced episodes of alternating activity in the ventral roots. Injections of Ringer's solution alone into those sites did not result in ventral root activity. The pattern of ventral root activity was similar whether the activity was spontaneous or evoked by chemical microstimulation, except that cycle time (which is inversely proportional to swimming speed) was typically greater with evoked activity. These results are the first to demonstrate the existence of locomotor initiation regions in an amphibian.

- 22 JONES, M. TILDON, ROBERT M. JETTON, AND WADE B. WORTHEN. Biology Dept., Furman University, Greenville, SC 29613. - Desiccation stress contributes to the nested subset structure of mycophagous fly communities.

In previous research, mycophagous fly communities emerging from *Agaricus bisporus* mushrooms exhibited nested subset structure related to mushroom size. Species emerging from small mushrooms were nested within communities emerging from large mushrooms. We tested the hypothesis that desiccation stress, differentially mediated by mushrooms of different size, was responsible for nestedness in this community. We placed 20 *Drosophila putrida* or *Drosophila tripunctata* first-instar larvae on small, medium, and large *A. bisporus* mushrooms and incubated them under three different thermal regimes, with peak temperatures at either 25, 30, or 35°C. Survivorship was effected by mushroom size and temperature; more flies emerged as mushroom size increased and as temperature declined; consistent with our hypothesis. We also placed halves of field collected mushrooms at two temperature conditions (peaks of 25 and 35°C) and sorted emerging metamorphs. Communities exposed to cool temperatures were not nested, but communities exposed to high temperatures were significantly nested. At high temperatures, small mushrooms dry out and can only support desiccation tolerant species. Large mushrooms, however, stay moist and support desiccation tolerant and desiccation sensitive species. This contributes to species-area patterns and nested subset structure in these communities.

- 23 Sepulveda, Shannon R. and Stephen B. White
Murray State University Student Chapter of The Wildlife Society -The Wildlife Diversity Funding Initiative: A potential new source of funding for research.

At the 1995 Association of Southeastern Biologists (ASB) paper session, 70.8% of the wildlife related papers dealt with nongame, nonendangered species. Also in 1995, 16.1% of the papers published in the Journal of Parasitology were field studies pertaining to the effects of parasites on vertebrate wildlife in the United States, and 59.4% of these dealt with nongame, nonendangered species. Currently new legislation known as The Wildlife Diversity Funding Initiative or Teaming With Wildlife (TWW) is being proposed and if passed would provide additional funding for nongame, nonendangered species research and conservation. This legislation, if passed, would establish a small federal excise tax on outdoor recreational equipment and would raise an estimated \$350 million. In the Southeast, this would increase the average state fish and wildlife agency budget by 16.7% (based on FY96 data). An increase in funding of this magnitude would mean an increase in the ability of state agencies to fund and support research on the nearly 1800 species of nongame, nonendangered wildlife found in this country. This funding could help support conservation related research by members of the ASB and the Southeastern Society of Parasitologists (SSP). Before TWW can be passed, additional support must be gained from the taxed industries, conservation organizations, and other associations such as the ASB and SSP.

- 24 DIMASI, M. KATIE, LINDA E. WATSON, and TIMOTHY M. EVANS. Department of Botany, Miami University, Oxford, OH 45056 - Molecular phylogeny of Tribe Anthemideae (Asteraceae), based on sequences of the internal transcribed spacers of nuclear ribosomal DNA.

The nuclear ribosomal genes consist of individual repeat units composed of three ribosomal protein genes, separated by two internal transcribed spacers (ITS). The repeat unit is present in 1000's of copies, arranged in a tandem array and separated by an intergenic spacer. The ITS are under weaker functional constraints than protein coding genes, because the spacers themselves do not code for proteins. Therefore, there is less selection pressure against deleterious mutations, which allows these regions to accumulate mutations and evolve at a faster rate. Additionally, the repeat units are evolving in a concerted fashion that results in a homogenizing effect, and effectively results in this gene family behaving as a single copy gene. Therefore, the ITS possess several characteristics that make them suitable for examining phylogenetic relationships among species and closely related genera. Consequently, we sequenced the ITS in representative genera from the Tribe Anthemideae (Asteraceae) for phylogenetic analysis, to test for concordance with a published morphological phylogeny, and to examine congruence with a phylogeny produced from sequence data of chloroplast gene *ndhF*. Interestingly, there is little concordance with the morphological tree and strong congruence with the *ndhF* tree, notwithstanding the fact that the ITS have a different evolutionary history as biparentally-inherited vs. maternal inheritance only for the chloroplast gene. This concordance between these two molecular phylogenies from two different genomes with different evolutionary histories provides strong

evidence that the molecular trees are probably a more accurate estimation of phylogeny than the morphological tree. Furthermore, there is greater resolution within some clades of the ITS tree than the *ndhF* tree. Combining the two molecular datasets has the potential to more fully resolve relationships in the Anthemideae at basal and terminal nodes.

- 25 MAYO, DOBB Dept. Biological Sciences, University of North Carolina at Wilmington and Center for Marine Science Research, UNCW - Eutrophication and its consequences on fish assemblages.

Increased nutrient levels can have a cascading effect on the higher trophic levels of estuarine communities. The objective of this study was to determine how ichthyofauna responds to this cascading effect. As part of a larger study, it was found that an increase in nutrient levels affects benthic fauna. Fish assemblages were found to change in relation to changes in the benthic fauna. The impact of increased nutrient levels caused an increase in overall fish abundance, while there was no response observed in fish species diversity. Analysis of gut contents reveals that fishes preyed upon those benthic taxa which directly increased with increased eutrophication. Persistent differences in the fish communities among creeks suggests that transient fish species exhibit more site selectivity or site fidelity than previously thought.

- 26 DANDRIDGE, KERI L. AND A. JOSEPH POLLARD. Department of Biology, Furman University, Greenville, SC 29613 - Variation in zinc and nickel hyperaccumulation by *Thlaspi caerulescens* from different soil types.

Hyperaccumulation of metals by plants has recently received considerable interest. One reason for this interest is the potential for phytoremediation of contaminated soils using hyperaccumulating species, which take up abnormally high amounts of potentially toxic metals in their roots, shoots, and leaves. One of these metallophytic species is *Thlaspi caerulescens*, a member of the family Brassicaceae, which is known to hyperaccumulate both Zn and Ni. We considered variation between and within five populations of *T. caerulescens*, growing in soils of different mineralogical origin. Seeds were collected in the field as sib families, from populations in England, Wales, and Spain. Seedling families were grown hydroponically, in culture solution containing either 10 ppm Zn or 0.5 ppm Ni. Plants were analyzed for metal content using atomic absorption spectrometry. Significant differences existed between the five populations in ability to accumulate both metals. Significant genetic variability within populations (as indicated by non-zero heritability values) was found in three populations for Zn, and in one population for Ni. The results suggest that natural selection for high metal concentration, for example as a deterrent to herbivory, could lead to the evolution of hyperaccumulation. They are also relevant to the genetic improvement of plants for phytoremediation through selection or gene manipulation.

- 27 BENNETSEN, DEREK and LINDA E. WATSON. Department of Botany, Miami University, Oxford, OH 45056 - Genetic variation in the invasive species *Lonicera mackii*.

Lonicera mackii (Caprifoliaceae), Amur Honeysuckle, was first introduced into the United States at the New York Botanical Garden in 1898, and is now present in 24 states in the eastern U.S., including Ohio. The Ohio population was introduced in the late 1950's in the Oxford area, and has spread to 33 additional counties. It has a wide range of habitats and thrives in disturbed areas, and exhibits a high level of fecundity, with its seeds dispersed by birds. To determine the pattern of dispersal and establishment of local populations in and around the Oxford area, we examined genetic variation using isozyme electrophoresis. We examined 18 populations for 13 enzyme systems, encoded by 20 loci. Ninety-five percent of the loci were polymorphic, with the mean number of alleles per individual locus at 2.40. A greater amount of variation was apportioned within populations rather than among populations, a characteristic trait of bird dispersed species. Genetic identities among populations ranged from 1.0 to 0.74. A UPGMA phenogram of genetic identities resulted in two distinct clusters that correspond to geographic locality. The populations peripheral to the city limits of Oxford are more closely related to each other than to populations located within central Oxford; and the central Oxford populations are more closely related to each other than to the peripheral populations. Therefore, the pattern of establishment and spread of the species in the Oxford area appears to be skewed toward few or only one source population. Because genetic patterns in relation to the invasive nature of some species has been hampered by the wide range of variability, we are examining RAPDs as an additional line of evidence.

- 28 SCHMIDT, JOHN M. Winthrop University, Dept. of Biology, Rock Hill, SC 29733 - Sex and Smut in a Clonal Sedge (*Carex picta* Stued.)

Infection is often considered a nuisance in plant population biology studies, yet pathogens are present in every naturally occurring system. The incidence and effects of these diseases are rarely known. The epidemiology of the smut fungus *Schizonella melanogramma* (Schröt.) and its dioecious host, *C. picta* were examined for three years in a beech-maple forest located in south central Indiana. *S. melanogramma*

is circumboreal, infects many *Carex* species and is characterized by linear rust-like lesions that form on leaves. The overall infection rate increased from 37.9% of all plants in 1990 to 48.6% in 1992, but the rate was the same for both female and male hosts in any given year. Plants that failed to flower during the three year period (33% of the total) formed a distinct group characterized by small size and higher rates of infection and mortality relative to reproductive plants. Sex did not affect the response of reproductive plants to infection. Females and males alike responded by decreasing culm production and increasing tillering. Analysis of the smut's spatial distribution revealed that infected hosts occurred in clumps, indicating that there were focal points of infection. Reproductive hosts of intermediate size were the least likely to be infected. Evidence suggests that the incidence of infection is a function of age, location and resistance.

- 29 SEWALK, CHESTER¹, GWENDA L. BREWER¹, AND DAVID HOFFMAN². ¹Frostburg State University, Frostburg, MD 21532 and ²Patuxent Wildlife Research Center, Laurel, MD 20708 - Effects of diquat on development in mallard embryos.

The bipyridinium herbicide, diquat, is commonly used as an aquatic weed control. Paraquat, also in this structural class, is highly toxic to avian embryos, but potential effects of diquat have not been studied. This study examined the effects of external egg application of diquat on development of mallard (*Anas platyrhynchos*) embryos. The LC₅₀ was found to be 67.8 g/l with brief egg immersion at day 4 of incubation and survival recorded through day 18 of incubation. When the LC₅₀ was determined through hatching, additional mortality at the time of hatching resulted in a much lower LC₅₀ of 11.2 g/l. Teratogenic effects included brain, bill, and skeletal defects. Diquat affected the status of reduced glutathione (GSH) in the liver and brain; GSH concentration was lower in livers and brains of 18-day-old embryos that were treated on day 4. Brain GSH was also lower in hatchlings treated on day 4 or day 21. A significant increase in the ratio of oxidized glutathione to GSH in the brain occurred in hatchlings following treatment at 21 days of incubation. Behavior of surviving ducklings did not appear to be affected. Although diquat is considerably less toxic than paraquat by this exposure route, it is a potential hazard to mallards and other aquatic birds due to high permissible application rates.

- 30 CHRISTY, ARTHUR M., JR. AND A. JOSEPH POLLARD. Department of Biology, Furman University, Greenville SC 29613 - Metal tolerance and accumulation in *Plantago lanceolata*.

Most heavy metals are toxic to plants when present at high concentrations; however, some plants show remarkable tolerance. Populations of *Plantago lanceolata* are known to evolve tolerance to a variety of metals including Zn, Cu, Pb and As, on sites contaminated with the respective metal(s). This study assessed whether a Zn-tolerant population of *P. lanceolata* from Silver Hill mine, Davidson Co., NC, shows evidence of tolerance to Ni, a metal not present at elevated concentrations at this site. It also considered whether Zn-tolerant and non-tolerant populations differ in their patterns of uptake of Zn and Ni from a hydroponic culture solution. Seeds from Silver Hill and from an uncontaminated site in Clemson, SC, were germinated and grown in 10% Rorison's nutrient solution. Plants were separated into three treatment groups: basal Rorison's solution (no Ni and trace Zn), basal solution plus 1.0 ppm Zn, and basal solution plus 0.25 ppm Ni. Tolerance was assessed by measurements of root and shoot growth. As predicted, the Silver Hill population showed greater Zn tolerance than the Clemson population, though the difference was less distinct than expected. There were no differences in Ni tolerance, confirming results from other species that such co-tolerance rarely if ever occurs. Both populations accumulated more Zn and Ni in their roots than in their leaves, but there were no differences in accumulation between the populations. There was an unexpected but significant finding that addition of Ni stimulated Zn accumulation in the roots of both populations.

- 31 WEISHAMPEL, JOHN F.,¹ DAVID J. HARDING,² JASON B. DRAKE,¹ and JEFFRY C. BOUTET.¹ University of Central Florida¹ Geodynamics Branch, NASA Goddard Space Flight Center² --Analysis of laser altimeter waveforms for forested ecosystems of central Florida

An experimental profiling airborne laser altimeter system developed at NASA's Goddard Space Flight Center was used to acquire vertical canopy data from several ecosystems types from The Nature Conservancy's Disney Wilderness Preserve, near Kissimmee, and nearby areas in central Florida. This laser altimeter provides submeter accuracy of tree height as well as 3-dimensional spatial information about forest canopies by capturing a profile of data which relates to the magnitude of reflectivity of the laser pulse as it penetrates different elevations of the forest canopy. This complete time varying amplitude of the return signal of the laser pulse, between the first (i.e., the canopy top) and last (i.e., the ground) returns, yields a waveform which is related to canopy architecture, specifically the nadir-projected vertical distribution of the surface of canopy components (i.e., the foliage, twigs, and branches). Selected profile returns from representative coartypes (e.g., pine flatwoods, hardwood hammocks, scrub, and cypress wetlands) were

compared with ground-truthed forest composition (i.e., species and size class distribution) and structural (i.e., canopy height, canopy closure, and crown depth) measures to help understand how these properties contribute to variation in the altimeter waveform

- 32 WOODHEAD, JENNIFER L. AND DANIEL B. PLYLER. University of North Carolina at Wilmington - *In vitro* propagation of threatened *Amaranthus pumilus*. *Amaranthus pumilus* is a threatened dune species that has demonstrated remarkable capacity for *in vitro* culture. This study encompasses the introduction of *A. pumilus* into culture. An auxin:cytokinin grid was used to observe the response of *A. pumilus* at various concentrations. Indole-3-acetic acid and 6-benzylaminopurine were investigated in combinations of 0, 1, 2 and 4 μM concentrations. The effects of the auxin and cytokinin were measured by the percent of explants producing callus, root or new growth from the apical meristem explants. Wet and dry weights were recorded. The growth regulators needed for a Stage II multiplication medium, a Stage III rooting medium and callus induction medium were deduced from the results of the grid. The proper concentration of growth regulators for each stage was added to a basal medium of 1/4 Murashige and Skoog Basal Salts, 3% sucrose and Murashige and Skoog vitamins. Acclimation of *A. pumilus* took place in pots filled with a 50:50 potting soil/sand mixture that were placed in plastic bags. Holes were punched in the bags to slowly acclimate the plants to a dryer atmosphere. In time, this method may help establish new plots of *A. pumilus* in its natural environment.

- 33 GAMBLE, ROBERT J. AND DAVID G. LINDQUIST. Dept. Biological Sciences, University of North Carolina at Wilmington - Using infrared satellite imagery to predict Gulf Stream intrusions into Onslow Bay, NC that may be transporting larval fish. Larval fishes are often carried long distances from where they were spawned by currents. Because of this, adult populations of fishes may be comprised of larval fishes spawned either in the same area as the adult population, in another area of the ocean, or a combination of the two. It is therefore of interest to be able to determine where the adult fishes in an area were originally spawned, both scientifically and commercially. There are currently projects at UNCW designed to determine if the Gulf Stream is transporting larval fishes into Onslow Bay through such events as meanders, eddies and frontal filaments, focusing primarily on the fishes that comprise the commercially important, snapper-grouper complex. One of the ways being used to determine if a Gulf Stream event is occurring in Onslow Bay is satellite imagery, specifically Advanced Very High Resolution Radiometer (AVHRR) images which show sea surface temperature (SST). While these images have limitations, when used properly they can be very useful for this purpose.

- 34 WOHL, DEBRA L. AND J VAUN MCARTHUR. University of Georgia, Savannah River Ecology Laboratory, Drawer E, Aiken, SC 29802 - Bacterial-fungal antagonism & the indirect effect on organic matter decomposition in lotic environments.

The role of hyphomycetous fungi in the decomposition of organic matter in streams has been well examined, although the role of bacterial antagonists in such processes has gained little attention. To examine bacterial antagonism, 10 bacterial isolates and one hyphomycete were collected from coastal plain streams and tested for an antagonistic response. Each experimental run consisted of a control group and 4 treatment groups. Controls were comprised of only sterilized stream water and macrophytes, the first treatment group was inoculated with a bacterial isolate (10^4 cells ml^{-1}), the second group was inoculated with only the hyphomycete *Aneurospora filiformis* (10^2 spores ml^{-1}), the third treatment group was inoculated with both bacteria and fungi simultaneously, and the fourth group was inoculated with bacteria 2 d after initial fungal establishment. The greatest rates of macrophyte decomposition were expected to occur in the presence of exclusively the fungus, whereas intermediate levels of macrophyte decomposition were expected in mixed microcosms due to bacterial antagonism inhibiting fungal activity. The lowest rates of decomposition were expected in control microcosms resulting from the absence of microbial activity and only physical degradation. In the control microcosms, macrophyte biomass did not change significantly over time. In the bacterial microcosms, more than 8 d were required to achieve a significant decrease in macrophyte biomass ($p < 0.05$), whereas the second treatment group (only fungus), exhibited a significant decrease in macrophyte biomass by 24 d. In both of the mixed microcosms (treatments 3 & 4), macrophyte biomass tended to decrease notably after 16 d and was predominantly comprised of bacteria. These results demonstrate that under certain conditions bacterial antagonism can indirectly affect the rate of organic matter decomposition.

- 35 BURSE, JEANINE R. AND HENRY L. BART JR. Ecology, Evolution, and Organismal Biology Dept., Tulane University, New Orleans, LA 70118 - Spawning frequency of the scaly sand darter, *Ammocrypta vivax*.

The scaly sand darter, *Ammocrypta vivax*, is a common and widely distributed inhabitant of sandy-bottom creeks and rivers of the Gulf Coastal Plain. Knowledge of the species' life

history is limited. I investigated spawning frequency of western Gulf Slope populations of *Ammocrypta vivax*; using specimens archived in the Tulane Museum of Natural History. This study is based on 489 specimens from samples collected over a 25-year interval (1956-1981). The specimens were measured (standard length) and subjected to length frequency analysis for growth approximation. The gonads from 225 specimens were weighed, and the weights expressed as the gonadosomatic index (GSI) to indicate spawning activity. The results suggest that *A. vivax* has two distinct spawning peaks (April and August). Ovaries from these months contain ripe eggs. Length frequency analysis reveals that young appear in June and September. Females mature at 41mm (SL), and the cohort that spawns in April also spawns in August.

- 36 RENNE, IAN J. Dept. Biological Sciences, Clemson University -Use and dispersal of the Chinese tallow tree *Sapium sebiferum* by birds in coastal South Carolina.

Seed traps (n=119) were constructed to quantify the interactions between birds and the Chinese tallow tree. At least 14 bird species dispersed an estimated $675,000 \pm 56,000$ out of $1,681,000 \pm 113,000$ seeds from tallow trees in spoil areas and coastal forests. The dispersal efficiency, or the proportion of available seeds dispersed, of trees among habitats approached significance ($p=0.0633$). Crop size and tree association (i.e., isolated or clustered trees) were not correlated with dispersal efficiency. Crop size was the best predictor of the number of seeds dispersed in both habitats ($p<0.0005$). In a greenhouse I tested whether seed treatment (defecated and unhandled by birds) and depth of burial (0 and 1 cm) affected germination. The rate and time of germination were affected by these factors ($p<<0.05$), with defecated, buried seeds having the highest rate and earliest date of germination ($p<<0.05$). The invasion of the Chinese tallow tree is likely to continue in many habitats in coastal South Carolina because of heavy use and effective seed dispersal by birds.

- 37 COOK, SUSAN B. AND DEBRA K KRUMM, Harbor Branch Oceanographic Institution, Fort Pierce, FL 34946 - Combining 'hands on' with 'high tech': using video and CD-ROM resources in effective field courses

The J. Seward Johnson Marine Education Center at Harbor Branch Oceanographic Institution is a full service education facility that offers a variety of college-level educational programs including accredited summer courses, programs for visiting groups, internships and faculty workshops. A primary goal of the Center is to develop effective ways to couple the use of modern technologies with field-oriented experiences for students. At least two examples of this approach will be presented with suggestions for implementation: 1) the use of video clips and CD-ROM modules to provide a preview of the exceptionally high biodiversity of the Indian River Lagoon Estuary region before class visits to specific field sites and 2) the use of a small remotely operated vehicle (ROV) to introduce students to ocean technology.

- 38 CONNER, WILLIAM. H. Baruch Forest Science Institute, Box 596, Georgetown, SC 29442 - Comparison of primary productivity of eight forested wetlands in South Carolina.

Productivity was examined in eight forested wetland sites in the SC coastal region during 1994. Objectives included: (1) characterization of hydrological patterns, nutrient conditions, and productivity, (2) determination of the variability/similarity of these variables, and (3) investigation of simple measures of ecosystem structure and abiotic conditions as predictors of primary productivity. Stands were grouped into four categories – rain-fed, tidal, permanently flooded, and small order stream. Paired 20-m x 25-m plots were established and trees tagged and measured. A water level recorder was placed in each stand. Litterfall was collected in ten 0.25 m² littertraps fitted with 1 m wooden legs or styrofoam bottoms. Seasonal growth patterns and annual stem production were measured using aluminum vernier dendrometer bands on dominant canopy trees. Water samples were taken monthly when standing water was present. Sediment samples (30 cm depth and 2.5 cm in diameter) were taken from randomly selected locations in all plots. Average litterfall ranged from 329 g/m²/yr to 651 g/m²/yr in the following order: stream > tidal > rain-fed > permanently flooded. Cumulative change in BA (cm²/yr) varied from site to site and species to species, and stem productivity ranged from 145 to 957 g/m²/yr with the highest and lowest values occurring in the permanently flooded areas. Although litterfall generally accounts for an average of 47% of the aboveground primary production in wetland forests, litterfall in the permanently flooded ACE site represented only 25% of net aboveground productivity. In contrast, litterfall represented 75% of the aboveground productivity at the permanently flooded Savannah River site. None of the biotic and abiotic variables measured in this study predicted the ranking of productivity found. When the eight sites were broken out by whether they were *Taxodium* or *Nyssa* dominated, phosphorus content of the water was found to be inversely related to productivity in *Taxodium* communities. In *Nyssa* communities, phosphorus in the soil was inversely related to productivity. Lumping of forested wetlands into one broad category based on hydrologic regime or nutrient level may not be appropriate. Some of the confusion and difficulty in looking for trends and predictors in this study may have due to extremely wet conditions that year. For a more complete understanding of whether biotic and abiotic variables can be used as predictors, longer data sets are being accumulated.

- 39 SPRATT, HENRY G., Jr., MELISSA R. ESLINGER, AND JENNIFER M. PULLIAM. The University of Tennessee at Chattanooga - Pretreatment carbon and sulfur transformations in A-horizon soils of the Missouri Ozark Forest Ecosystem Project.

Transformations of C and S were determined for A-horizon soils collected from 27 permanent plots located in the Missouri Ozark Forest Ecosystem Project (MOFEP) in southeastern Missouri on 11 dates from Aug 1993 to May 1996. Mineralization of ^{14}C -lignin and ^{14}C -cellulose (of *Quercus alba*, the dominant tree species on MOFEP plots) was used as a measure of microbial activity in the soils. Sulfur transformations determined included microbial production and mineralization of organic sulfur (OS), using established ^{35}S methodology. Sulfur pools quantified included: total sulfur (TS), water soluble SO_4^{2-} , adsorbed SO_4^{2-} , and OS (determined by difference). Microbial activity was seasonal, with max. rates of lignocellulose mineralization occurring on warm sample dates, as expected for microbial processes. Sulfur pools were dominated by OS on all dates sampled (OS ranged from 94.9 % to 98.9 % of TS, 19.4 ± 1.6 to $42.8 \pm 3.4 \mu\text{mol/g dry}$), and generally exhibited seasonal variation (higher concentrations on warmer sample dates). The microbial production of OS also tended to be greatest for warm sampling dates (max. rate observed = $20.0 \pm 1.5 \text{ SE}$, min. rate observed = $2.7 \pm 0.3 \text{ SE}$, nmol/g dry/da) and correlated with lignocellulose mineralization. Turnover of the microbially produced OS occurred quickly, with production rates and mineralization rates about equal. Beginning in May of 1996, trees from two thirds of the plots used in this study were harvested by either clear cutting or selective cutting. Future studies of these plots will be compared with the pretreatment data presented here to access the overall effect of timber harvest technique on surface soil carbon and sulfur transformations as part of MOFEP. This work has been supported by grants from the Missouri Department of Conservation.

- 40 MARTIN, WILLIAM A. and FRANK S. GILLIAM. Dept. Biological Sciences, Marshall University, Huntington, WV. 25755. - Response of soil metal cations to nitrogen deposition in a Central Appalachian Hardwood Forest.

The phenomenon of excessive nitrogen (N) inputs associated with acidic deposition, known as N saturation, has been hypothesized to contribute to reduced forest productivity. Among the proposed mechanisms of saturation-induced decline is the loss of nutrient cations, such as Ca and Mg, which are leached from the soil with NO_3^- . This study examined soil cations in three watersheds in the Fernow Experimental Forest, West Virginia to see (1) if metal cations changed in extractability during soil incubation and (2) if such changes, if any, respond to chronic N inputs. The watersheds were: WS3 (young treatment); WS4 (mature control); WS7 (young control). WS3 has received aerial applications of $(\text{NH}_4)_2\text{SO}_4$ three times per year since 1989 (54 kg N/ha/yr). Mineral soil was incubated *in situ*, being placed in bags and buried every ~30 days during the growing season in each of the seven sample plots per watershed. Moist samples of soil were extracted with dilute double-acid and analyzed for extractable Ca, Mg, K, Na, Al, Fe, and Mn using inductively-coupled plasma emission spectrometry. Preliminary results indicate few changes in ion concentration over the incubation period. Al was the dominant cation in all samples, consistent with the extremely acid nature of the soils. Nutrient cations (Ca, Mg, K) were low, likely from the development of these soils from parent materials low in weatherable bases. Data suggest a minimal response of cations to the N treatment on WS3.

- 41 DILUSTRO, JOHN J. AND FRANK P. DAY. Old Dominion University.-- The initial response of fine roots to elevated atmospheric carbon dioxide in an oak-palmetto scrub ecosystem.

The belowground ramifications of increasing atmospheric carbon dioxide are not yet fully understood. Open top chambers with both ambient and elevated carbon dioxide treatments were constructed in an oak-palmetto scrub ecosystem at Kennedy Space Center, Florida. Minirhizotron tubes were installed in each elevated and control chamber. Each tube is sampled every three months. Preliminary results showed an increase in root length density (RLD) at the 0 to 35 cm depth from March to June, 1996. Initial measurements taken in March were 2.92 mm cm^{-2} for the enriched and 2.68 mm cm^{-2} for the control plots. Carbon dioxide enrichment began May 15. The enriched plots showed a higher root length density (8.52 mm cm^{-2}) than the control plots (6.85 mm cm^{-2}) by the June sampling. Results will allow us to examine fine root production and root mortality, both of which influence carbon sequestering in the soil.

- 42 COLLINS, CHRISTI, AND RAYMOND L. PETERSEN Dept. of Biology, Howard University, Washington, DC 20059 - The effects of ozone deposition on the cinnamon fern *Osmunda cinnamomea* L. in the Monongahela National Forest, West Virginia.

The seasonal progress of ozone deposition on the cinnamon fern *Osmunda cinnamomea* L. (Osmundaceae) was tracked for 28 populations distributed widely throughout the Monongahela National Forest, West Virginia. Populations were also selected for varying ranges in elevation to assess the relationship, if any, between elevation and ozone deposition. For each population, ten clones of the fern were identified for study at the beginning of the growing season. Based on previous controlled fumigation experiments, plants exposed to ozone develop inter-veinal bronze flecking on the adaxial surface of the pinnales. The populations were monitored from June through August of 1995 for these symptoms. The number of clones exhibiting ozone symptoms increased steadily through

the assessment period for most populations, at the end of which the average number of clones exhibiting some degree of ozone damage/population was seven. For the first half of the growing season there was a positive correlation between the incidence of ozone damage and the elevation of a population. This trend was less evident for the later half of the growing season. *Osmunda cinnamomea* appears to be a sensitive indicator of ozone pollution and can be considered a suitable species for monitoring forest health. Supported by the USDA - Forest Service (Eastern Region).

- 43 ROBERTSON, JENNIFER L. AND HOWARD S. NEUFELD. Department of Biology, Appalachian State University, Boone, NC, 28608 - Ecophysiological significance of carbon gain by phyllodia and pitchers in carnivorous pitcher plants.

Sarracenia is a genus of carnivorous pitcher plants endemic to North America. Among the ten species of pitcher plants, only three closely related species (*S. flava*, *S. leucophylla*, *S. oreophila*) produce phyllodia: specialized leaf-like structures not involved in capturing insects, as occurs with pitchers. The ecological significance of these structures is not well understood, nor is it clear why only these species produce them. Therefore we decided to study the ecophysiological significance of phyllodia production in *Sarracenia*. Light interception patterns for phyllodia and pitchers were determined using fiber optic spectroscopy, allowing the relationship between internal leaf anatomy and light interception to be assessed. Carefully prepared optic fibers were inserted into a leaf 20 μm at a time. The spectral distribution and absorption patterns were recorded on a computer. Leaves were also labeled with $^{14}\text{CO}_2$ to follow carbon assimilation patterns. Leaf samples were paradermally sectioned into 40 μm thick sections and then placed into a scintillation counter to determine which sections fixed CO_2 . Additional leaf samples were sectioned similarly for chlorophyll content. These data are currently being analyzed, and we will be relating light gradients to location of chlorophyll and carbon fixation within leaf samples. We would like to thank Dr. Tom Vogelmann of the University of Wyoming for allowing us to complete this work in his laboratory.

- 44 WILLIAMS, DENISE AND HOWARD S. NEUFELD. Appalachian State University, Boone, NC 28608 -- Factors affecting the spread of the introduced species, *Microstegium vimineum*, a shade tolerant, C_4 grass.

Microstegium vimineum is a grass native to southeast Asia that has invaded much of the eastern United States. It has become a well-established pest in the Southeast and Mid-Atlantic states and has been steadily progressing northward. It is unusual among invasive C_4 grasses in that it is shade tolerant and that it appears to be limited to moist soils. Our research objectives were to determine the environmental tolerance limits to growth and reproduction and to determine whether environmental factors affect its reproductive strategy. *M. vimineum* is capable of producing both cleistogamous and chasmogamous flowers, a factor which may play a role in its colonizing success. Field experiments were carried out in four study sites in Great Smoky Mountains National Park. Light intensity, mid-season soil moisture, flower type, plant density and biomass were measured in 0.25m x 0.25m quadrats along a line transect through each site. One site showed a negative correlation between light intensity and biomass while data for the other sites were inconclusive. No sites showed a correlation between soil moisture and biomass. Flower data are currently being analyzed. This year we plan to grow *M. vimineum* in the greenhouse under a soil moisture gradient with high and low light regimes to more clearly define the effects of light and soil moisture on growth and reproduction.

- 45 LIU, HONG, AND SPIRA, TIMOTHY P. Clemson University - Influence of Seed Age on Seed Germination, Seedling Vigor, and Inbreeding Depression in *Hibiscus moscheutos*

Seeds of many species form seed banks in the soil which may stay viable for multiple years. However, the extent to which seed age influences germination and seedling growth rates is largely unknown in non-agricultural species. In this study, we use *Hibiscus moscheutos*, a self compatible herbaceous perennial that occurs in wetlands of the eastern US to look at seed age influence on seed germination (rate and percentage) and seedling growth rate. Preliminary results for this greenhouse study indicate that seed age had a significant negative effect on seed germination; however, three-year-old seeds had faster growing seedlings than one-year-old seeds. In addition, we tested the hypothesis that inbreeding effects become more pronounced as seeds age (a topic for which little information is available). Our preliminary results indicate a trend (although not significant) whereby three-year-old seeds had more pronounced inbreeding depression (based on germination percentage and seedling growth rate) than one-year-old seeds. A modified experiment is underway to further assess the influence of seed age on germination, seedling growth, and inbreeding effects.

- 46 MAURAKIS, EUGENE G. AND DIANA L. LIPSCOMB. Science Museum of Virginia and George Washington University - Historical relationships of Atlantic slope river drainages.

An analysis of the historical relationships of 19 river drainages (St. Lawrence to Altamaha) on the Atlantic slope of the Appalachian Mountains was conducted using the shared presence of 124 native species of cyprinid fishes. This analysis resulted in an area cladogram that suggests that the rivers of the southern Atlantic slope were historically connected to the drainage of three southern rivers (Flint, Chattahoochee, and Apalachicola) which drain into the Gulf of Mexico. The mid-Atlantic and northern Atlantic slope rivers appear to be historically related in support of earlier hypotheses that the mid-Atlantic region provided a refugium for fishes to disperse to the north following retreat of the glacier and rising sea levels at the end of the Pleistocene. Methods for testing these conclusions are discussed.

- 47 JOHNSTON, C. E.¹, J. R. SHUTE², P. L. RAKES³, AND P. W. SHUTE³. ¹USDA Forest Service, Southern Research Station, Oxford, MS 38655; ²Conservation Fisheries, Inc., Knoxville, TN 37917; and ³Tennessee Valley Authority, Natural Heritage Program, Norris, TN 37828 - Long-term monitoring of rare fishes in the Conasauga River, Tennessee and Georgia.

The Conasauga River (Mobile Bay drainage), Georgia and Tennessee, harbors a diverse aquatic fauna which includes several federally listed species of fishes (e.g., *Percina jenynsii* - endangered; *Percina antesella* - endangered; *Cyprinella caerulea* - threatened), as well as several species that are considered imperiled by state agencies (e.g., *Etheostoma brevirostrum*; *Etheostoma ditrema*; *Etheostoma trisella*; *Notropis lineapunctatus*; *Noturus munitus* *Percina lenticula*). The river is unimpounded, and retains good water quality and an extensive riparian zone in some areas, primarily as a result of running much of its course through National Forest lands devoted to recreational use. Due to the high quality of habitat in the Conasauga River, it is the last refuge of several aquatic species that have been extirpated in other parts of their range. We have established a long-term monitoring program targeting three imperiled species of fishes: *Cyprinella caerulea*, *Etheostoma brevirostrum* and *Percina jenynsii*. Data for the first two years of our project will be presented, and other aspects of our project will be discussed.

- 48 MENHINICK, EDWARD F. Dept. Biology, University of North Carolina at Charlotte - A study of the fishes the Uwharrie National Forest.

The Uwharrie National Forest occupies much of Montgomery County in central North Carolina and is located between Charlotte and Raleigh. It is in the unique Uwharrie Formation of the Carolina Slate Belt, an area dominated by slate rich in biotite and chlorite. The Forest is drained by the Uwharrie River and the Little River; five small streams enter reservoirs of the Yadkin River directly. 40 stations covering all major streams of the Forest were sampled for fishes and water quality. 10 "ubiquitous" fishes occurred in all types of streams of the Forest. Six "large-stream" species occurred only in the Uwharrie River and lower sections of the Little River. Eight "small-stream" species were found only in tributary streams and the upper Little River. In addition, 6 species occurred only in lower elevation sections of the southern part of the forest. IBIs were determined for each station but were often misleading. Most streams in the Forest had good water quality and serve as a valuable basis of comparison of polluted streams in other sections of the Piedmont. This work was supported by a grant from the U.S. Forest Service.

- 49 ONORATO, DAVE,¹ ROBERT A. ANGUS¹, MELINDA M. LALOR², AND KEN R. MARION¹. ¹Department of Biology and ²Department of Civil and Environmental Engineering, University of Alabama at Birmingham, Birmingham, AL 35294 - Potential changes in the composition of ichthyofaunal assemblages in the upper Cahaba River as a result of urbanization.

The drainage basin of the upper Cahaba River in central Alabama has undergone rapid urbanization during the past 10 to 15 years. During the fall of 1995 and spring of 1996, an ichthyofaunal bioassessment was conducted on the Upper Cahaba River to determine the effects that urban and suburban growth have had on the fish assemblages in this system. When compared to historical studies on the Cahaba River, our data indicate that several species which were once quite common have now become less abundant at several sites. These include several species of cyprinids and percids, some of which are considered to be pollution sensitive. Alterations in the overall composition of ichthyofaunal assemblages at differing sites have also been noted. These

changes can likely be correlated to the urbanization of the area surrounding the upper Cahaba River.

- 50 DEVIVO, JOSEPH C.¹, CAROL A. COUCH², and BYRON J. FREEMAN¹. ¹Institute of Ecology, Athens, GA 30602 and ²United States Geological Survey National Water Quality Assessment Program, Atlanta, GA 30363 - Preliminary use of an Index of Biotic Integrity in urban streams around Atlanta, Georgia.

Data from 46 fish assemblage surveys collected at 21 stream sites in the vicinity of metropolitan Atlanta were analyzed to develop a preliminary Index of Biotic Integrity (IBI) for second- to fourth-order tributaries of the upper Chattahoochee River. Water chemistry and contaminants in bed sediments from 11 of these sites were also analyzed using principal components analysis (PCA) to determine a gradient of environmental quality. The first PCA axis accounted for 53.3% of the chemical variation among the 11 sites. Scores of sites along PCA axis 1 were mostly determined by sediment metal (Pb, Ag, Cd, Hg, and As) and nutrient concentrations, and specific conductance. Human population density of watersheds upstream from sites was significantly negatively correlated with PCA axis 1 and was used as a gradient of watershed development to test the applicability of individual IBI metrics. Based on assemblage responses across the gradient of watershed development, eight metrics were selected for inclusion in the IBI: percentage of gravel-dwellers, benthic invertivores, generalized feeders, and non-native fishes; number of native sucker and minnow species; native species diversity; and dominant nest-associate cyprinid.

- 51 MAYO, DOBB^{1,2}, LINDA LOMBARDI¹, TROY ALPHIN¹, AND MARTIN POSEY¹. ¹Dept. Biological Sciences, Univ. North Carolina at Wilmington and ²Center for Marine Science Research, UNCW - Recovery of a fish community from a catastrophic event.

Disturbance can be an important process in structuring communities, however, long-term influences of disturbances depend upon a community's resilience. In this study we analyzed responses in a fish assemblage in southeastern North Carolina to a catastrophic event -- a hurricane. Hurricane Fran made landfall in Wilmington, NC, as a category three storm with sustained winds of 115 m.p.h. and a storm surge of 15 feet. This perturbation temporarily disrupted the fish community. The immediate effect of the hurricane was a three-fold increase in fish abundance within a coastal creek system four days after the event. Twelve days after the event, abundances within the creek dramatically declined with only 18% of the pre-hurricane abundance. Twenty days after Hurricane Fran, the total abundance of fish returned to seasonal norms. The composition of the fish community was also altered immediately following the hurricane with an increase in pinfish, spot and mummichogs and a relative reduction in menhaden and killifish. Diet studies of the pinfish, *Lagodon rhomboides*, indicated it altered its diet immediately after the hurricane to include a greater proportion of pelagic fauna. This was associated with a decline in benthic faunal abundances within core samples taken at the site. Not until the end of this study did the relative gut content composition of flora, fauna and substrate return to pre-hurricane levels.

- 52 MCREYNOLDS, WILLIAM M. , MICHAEL L. LITTLE, AND DONALD C. TARTER. Department of Biological Sciences, Marshall University, Huntington, WV 25755 - Observations on isozyme patterns and meristics in mosquitofish (Pisces: Poeciliidae) from West Virginia, Kentucky, and Virginia.

Prior to 1988, two subspecies of the mosquitofish *Gambusia affinis* (*G. a. affinis* and *G. a. holbrooki*) were recognized along the Gulf and Atlantic Coasts of the United States. Based on electrophoretic analysis, subsequent investigators proposed the original taxonomic designation recognizing *G. holbrooki* and *G. affinis* as separate species. Populations in drainages west of Mobile Bay should be considered *G. affinis*, and those east of this divide being *G. holbrooki*. The only population of mosquitofish in West Virginia is found in the Meadow River wetlands (1392 ha) located at the western end of Greenbrier County in the Allegheny mountain province. Using heart, skeletal muscle, and brain tissues, malate dehydrogenase isozyme patterns, along with some morphometric characteristics (e.g. dorsal and anal fin rays, etc.), were used to determine the correct designation of the mosquitofish population in the Meadow River wetlands. Based on preliminary observations of electrophoresis and meristics, the West Virginia population is *Gambusia affinis*.

- 53 STRANGE, REX MEADE^{1,2}, AND BROOKS M. BURR¹. ¹Dept. Zoology, Southern Illinois University, Carbondale, IL 62901 and ²Dept. Biological Sciences, University of Alabama, Tuscaloosa, AL 35487 - Genetic Variability and Metapopulation Dynamics in the Threatened Blackside Dace, *Phoxinus cumberlandensis* (Pisces: Cyprinidae).

We examined the metapopulation structure of the threatened blackside dace, *Phoxinus cumberlandensis*, through mitochondrial DNA (mtDNA) analysis. Nine mtDNA haplotypes were identified among 108

individuals from 10 populations. Haplotype distribution is non-random among blackside dace populations, and a modest but significant correlation between stream distance and genetic divergence between populations is evident. Genetic structure as revealed through cluster analysis and tests of heterogeneity suggest that the species consists of three or four metapopulations: one centered in the upper Poor Fork through Straight Creek stream systems, another comprising the stream systems from Stinking Creek to Youngs Creek, and a third centered around Marsh and Jellico Creeks. Populations occurring below Cumberland Falls may be distinct and constitute a fourth group. We recommend that recovery plans address the task of conservation of the metapopulations as management units in order to preserve genetic diversity. This involves habitat and dispersal corridor protection and carefully planned re-introductions. Trans-locations between metapopulations should not be undertaken in the blackside dace.

- 54 FRANCKO, DAVID A., ROBERT S. WHYTE, HEATHER D. VANCE, AND KATHLEEN L. DEGROFT. Dept. of Botany, Miami University, Oxford, OH 45056 - Biotic and abiotic factors affecting patch dynamics in wetland communities dominated by *Nelumbo lutea* (American lotus).

Nelumbo lutea (American lotus), a keystone member of floating-leaved macrophyte communities in the southern U.S., is also a dominant species in Lake Erie coastal wetlands of Ohio, where lake effect microclimate extends the growing season to ca. 200 days. We have been investigating the year-to-year and seasonal patch dynamics of *Nelumbo* and associated wetland and aquatic plants in the Old Woman Creek National Estuarine Research Reserve near Huron, OH. In data collected from the field from 1993 - present and in associated greenhouse and laboratory experiments we have determined that; 1) *Nelumbo* currently covers 40-50% of the estuary surface, 2) the % cover has varied historically in response to light regime/turbidity/lake level and perhaps competition, 3) recruitment from the OWC sediment seed bank alone cannot account for observed *Nelumbo* patch dynamics and overall species diversity, 4) winter-induced freeze scarification cannot induce *Nelumbo* seed germination, and 5) *Nelumbo* may produce allelochemical agents that affect water milfoil and other co-occurring macrophyte species. These results are important to modeling *Nelumbo*-dominated wetlands, not only in the Great Lakes but also in southern inland water bodies.

- 55 HALL RUTHERFORD, REBECCA AND THOMAS WEAKS. Department of Biological Sciences, Marshall University, Huntington, WV 25755 - The effects of water quality on periphyton communities of the New River Gorge National River, West Virginia.

Periphyton community structure was studied in ten tributaries of the New River Gorge National River. This area is a large tourist attraction for West Virginia for sporting, recreation, white water rafting, etc. Five of these streams receive moderate to high levels of industrial and domestic organic pollutants. The other five streams do not receive high amounts of industrial waste and are generally free of domestic pollutants. The streams were sampled four times during the year. The pH, chlorophyll, temperature, dissolved oxygen, turbidity, conductivity and alkalinity were measured. Periphyton was identified and the cell density was established for each stream. Periphyton community indices and coefficients were calculated for water quality indicators in order to identify possible pollutions sources.

- 56 GREENE, STEPHEN D. AND DONALD C. TARTER. Dept. of Biological Sciences, Marshall University, Huntington, WV 25755 - Simultaneous chemical and benthic diversity comparisons of acid mine drainage and unmitigated lotic systems.

Acid mine drainage research does not lend itself to simultaneous temporal comparisons of the type normally found in scientific studies. True treatment and control ecologies existing simultaneously are found in Logan Co., West Virginia. Two stream forks join to form a stream order two lotic system, draining watersheds with the same geological profiles, topographies, and riparian vegetation that create this site. The South Fork has been strip mined, then abandoned for approximately 20 years. The North Fork has yet to be mined. Aluminum hydroxide precipitates from solution due to the increased pH of acidified South Fork water upon mixing with runoff from the North Fork. This precipitate covers the stream bed almost to the receiving stream, about 3 miles away. This unusual occurrence appears to be caused by runoff seeping through exposed coal seams, becoming acidified, and draining into the watershed upon hitting an impervious clay horizon, the aluminum source. Aluminum stays in solution until confluence of the forks where the zone of precipitation is immediate and clearly demarcated. Initial benthic biodiversities indicate the unmitigated South Fork has by far the greatest biodiversity. The stream below the confluence has greatly reduced

biodiversity, while the acidic North Fork has little biodiversity. Stream chemistries, with emphasis on metals, are being compiled to typify and compare these ecologies.

- 57 HENRY, ANDREA L. AND DONALD C. TARTER. Department of Biological Sciences, Marshall University, Huntington, WV 25755 - Ecological observations of *Crangonyx pseudogracilis* Bousfield (Crustacea: Amphipoda) from the Green Bottom Wildlife Management Area, Cabell County, West Virginia.

Although the genus *Crangonyx* has been studied in the Appalachian area, most of this work has concentrated on subterranean species. A *Crangonyx pseudogracilis* population from a Green Bottom Swamp was sampled weekly for 18 months to investigate the life history of amphipod. Laboratory studies were done to find low pH tolerance and diet of the amphipod. The 96-hr median tolerance limit (TL_m) for *Crangonyx pseudogracilis* was 4.06, found by linear regression analysis. Gut analysis of 10 specimens per month showed that plant detritus is the preferred food year round, ranging from 47% of the total diet in summer to 62% in fall. Filamentous algae represented 18-34% of the diet with diatoms, animal detritus and mineral being minute components. Life history information will be presented on sexual maturity, ovigerous females, fecundity, hatching, sex ratio, growth, and longevity. Results will be compared with other ecological investigations on amphipods.

- 58 ADERMAN, JENNIFER A. AND DONALD C. TARTER. Department of Biological Sciences, Marshall University, Huntington, WV 25755 - Acid tolerance, under static bioassay conditions, of the freshwater prawn *Palaemonetes kadiakensis* Rathbun from the Green Bottom Mitigation Site, Cabell County, West Virginia.

Acidification can have major impacts on crustacean populations. Low pH can alter respiration, acid-base balance, and Na and Ca regulation. Using a standard D-shaped dredge, one-hundred prawns (15.4-36.1 mm, $\bar{x}$ =25.6 mm) were collected from the Green Bottom Mitigation Site near Huntington, West Virginia. The water temperature was 10 C. Prawns were returned to the laboratory and allowed to acclimate for 24 hours in a controlled environmental chamber (10 C). They were experimentally tested to determine their tolerance to low pH. Ten prawns were placed in each of five duplicate bowls. They were exposed to the following pH values: 1.5, 3.0, 4.5, 6.0, 7.5 (control). After the 96-hour experiment, the TL_m (median tolerance limit) was calculated using linear regression analysis. The TL_m pH value was 5.03. Results will be compared with other laboratory and field studies on pH tolerance value on crustaceans.

- 59 GRAY, MARGARIT. Erskine College and Clemson University - Calcium release from *Corbicula fluminea* shells in oligotrophic lakes

One of the most important chemical limits for mollusks is calcium, which is necessary for shell growth. In systems where calcium is plentiful, the calcium stored in a clam shell is only a minor source of the overall calcium available. In an oligotrophic system such as Lake Hartwell, S.C., the amount of calcium released from shells and the rate of dissolution may play an integral part in the total amount of calcium available. The rate at which shells of dead *Corbicula* release calcium back into the water was determined for crushed and uncrushed shells. In a year the uncrushed shell from an average 20 mm clam can release 130 ppm calcium and the crushed shell can release 251 ppm calcium. The rate of calcium dissolution is also affected by temperature. The amount of calcium dissolved from crushed and uncrushed shells at 15, 25 and 35 degrees C. was determined. Calcium release from uncrushed shells (of the average 20 mm clam) was 160 ppm at 15 degrees C. and 91 ppm at 35 degrees C.

- 60 MCFADDEN-WENIG, COLLEEN^{1,2}, and HENRY G. SPRATT, Jr.² ¹Prog. in Mathematical Ecology, Univ. of Tennessee at Knoxville, TN 37996 and ² Dept. of Biological and Environmental Sciences, Univ. of Tennessee at Chattanooga, TN 37403 - The effect of backflushing sand filtration systems on bacterial nitrification in freshwater and saltwater aquaria at the Tennessee Aquarium.

Rates of bacterial nitrification were determined for samples collected from pressurized sand filtration systems at various times since backflushing for both freshwater and saltwater aquaria at the Tennessee Aquarium in Chattanooga, TN. Samples of sand from two depths in the filters were removed using a piston core sampler, and 10 cc of this sand was added to erlenmeyer flasks, combined with 220 ml of surface water collected from the tank, and spiked with NH₃ to a concentration of approximately 5 ppm to initiate incubations. Rates of nitrification were calculated by measuring loss of NH₃ from solution over time using an ion selective electrode. The range of nitrification rates observed (nmol·cm⁻³·da⁻¹) was from 81.28 ± 3.05 (SD, n=3) to 123.04 ± 9.36 for the freshwater system, with the greatest rate occurring

approximately one week since backflush. An eight hour lag in nitrification was observed for the freshwater system backflushed the same day as sampling. For the marine system, rates of nitrification ranged from 29.60 ± 1.23 to 64.32 ± 13.94 . More rapid nitrification was observed in sand collected from the surface of the filters (0-5 cm) than sand collected at depth (30-35 cm). Additionally, greater rates of nitrification were measured for the filter backflushed three days prior to sampling as opposed to the filter backflushed the morning of sampling. This data suggests that nitrification in filters of either freshwater or saltwater aquaria is sensitive to backflushing, with the marine system potentially compromised immediately after backflushing with fresh water.

- 61 BEARD, CHARLES E. AND PETER H. ADLER. Clemson University - Distribution of trichomycete fungi in black flies

Most larval black flies harbor obligate, endosymbiotic trichomycete fungi. One of the most commonly found trichomycetes in black flies (Diptera:Simuliidae) is the species *Harpella melusinae*. This genus is known only from black flies. *Harpella melusinae* has previously been recorded from North America, Japan, Europe, Australia, and New Zealand. We report finding this species in larvae from China, Iceland, Russia, Taiwan, and Thailand. This species is not found in the neotropical areas but, instead, a different species of the same genus is present in Chile and Brazil. In a given stream, trichomycetes colonize nearly 100 percent of the black fly larvae or occur in very low to zero numbers. This suggests that local, but as yet unknown, environmental factors control distribution.

- 62 WIKLE, RE, MOORE, XC, and JARECKI-BLACK, JC, Rhone Menieux, Inc. — Canine Lyme disease (LD): efficacy and lack of interference of an OspA combination vaccine

Canine LD, caused by *Borrelia burgdorferi* infection, is being reported more frequently as awareness of the infection increases among veterinarians. Previously, one of the major surface proteins of *B. burgdorferi*, designated OspA, has been shown to provide protection against spirochete infection in a variety of animals. Recently, an OspA monovalent vaccine was licensed; the first canine vaccine produced through recombinant technology to be licensed commercially. A combination vaccine, which would provide protection against *B. burgdorferi* and other canine pathogens simultaneously, would offer an important alternative. The present study determined the efficacy of such a vaccine. The combination vaccine was composed of an OspA diluent (OspA) and a lyophilized viral cake (recombinant Canine Distemper virus-Adenovirus Type 2-Coronavirus-Parainfluenza-Parvovirus; recDACPiP_{KL}). Thirty-three beagles received two injections of recDACPiP_{KL}+OspA or recDACPiP_{KL} alone (controls). All dogs were challenged seven weeks after the second vaccination with naturally infected ticks. Dogs were biopsied and skin samples cultured for spirochete reisolation. Lack of interference testing and viricidal assays were performed to confirm that the OspA diluent did not interfere with viral vaccine components. ELISA results demonstrated that the combination vaccine induced OspA seroconversion in 100% of the vaccinates as compared to the controls. Significant protection against *B. burgdorferi* challenge was evident from spirochete reisolation results. One vaccinee exhibited a transitory infection at the time of the first biopsy, but this dog was negative at the second biopsy. In contrast, samples from seventy-five per cent of the control group were positive for spirochete reisolation at the second biopsy. *In vitro* testing demonstrated that the OspA diluent did not interfere with the viral components of the vaccine. Study results also demonstrate the safety of the combination vaccine; no adverse local or systemic reactions were observed in any of the puppies. These results demonstrate that a canine vaccine, composed of an OspA diluent in combination with other canine viral antigens, is both safe and efficacious, as evidenced by a reduction in spirochete reisolation rates and lack of interference on viral components of the vaccine.

- 63 PRENTICE, ERIK and CHERYL D. DAVIS. Western Kentucky University-Enhanced resistance to *Trypanosoma cruzi* at elevated environmental temperature: Successful adoptive transfer to naive mice.

C3HeB/FeJ mice, which are highly susceptible to infection with the Brazil strain of *Trypanosoma cruzi*, not only survive infection when maintained at elevated environmental temperature but also experience reduced parasitemias and enhanced immune responsiveness. The goal of the present study was to determine if this enhanced resistance could be transferred to naive recipients by adoptive or passive transfer. Naive mice were injected with 10^7 spleen cells from non-infected mice or from mice which had survived infection with *T. cruzi* by being maintained at an elevated temperature of 36°C (36I mice). Alternatively, mice received weekly intraperitoneal injections of plasma from non-infected mice or from 36I mice. Twenty-four hours following the injection of spleen cells or the first injection of plasma, mice were infected with 10^3 blood-form trypomastigotes. All mice receiving plasma (from normal or 36I mice) or spleen cells from non-infected mice died by day 54 of infection, with high parasitemias. In contrast, all mice which received spleen cells from 36I mice have survived to date, with low parasitemias throughout infection, and clearance of circulating parasites by day 55.

- 64 HOU, YUE and CHERYL D. DAVIS. Western Kentucky University-Beneficial effect of vitamin E and selenium during experimental Chagas' disease.

The purpose of the present study was to determine if vitamin E and selenium could have a positive synergistic effect during experimental Chagas' disease. C3HeB/FeJ mice were infected with a Brazil strain of *Trypanosoma cruzi* while receiving vitamin E supplementation of 0 IU/kg, 200 IU/kg, 400 IU/kg, 600 IU/kg, or 800 IU/kg in their diet. After 51 days of infection, survival rates ranged from 0% (vitamin E-deficient group) to 60% (group supplemented with 400 IU/kg of vitamin E). The lowest parasitemia levels were observed in mice receiving 400 IU/kg or 600 IU/kg of vitamin E. Parasite-specific antibody levels were measured on day 20 and day 35 post-

infection using an enzyme-linked immunosorbent assay. No significant differences were observed among the treatment groups. However, a statistical analysis which included parasitemia, weight and parasite-specific antibody data revealed that dietary supplementation with 400 IU/kg of vitamin E provided the greatest overall benefit to mice during infection ($P < .05$). The possibility of a synergistic effect of vitamin E and selenium during infection with *T. cruzi* is currently being investigated.

- 65 BOGITSH, B. J., R. RIBEIRO-RODRIGUES, M. R. STENGER, and C. E. CARTER. Vanderbilt University—In vitro effects of the antitubulin trifluralin on *Trypanosoma cruzi* epimastigotes

Trifluralin, a dinitroaniline antitubulin, has been previously reported as a promising leishmanicidal agent. *Trypanosoma cruzi* epimastigotes were maintained axenically in liver infusion tryptose (LIT) medium and exposed to varying micromolar concentrations of trifluralin for 3-5 days at 28°C. For all experimentals and controls, either acetone or dimethoxysulfoxide (DMSO) were used as solvents. To determine the effects of trifluralin on the ultrastructure and uptake of horseradish peroxidase (HRP), HRP was added to the cultures for 60 minutes. The parasites were washed and prepared for cytochemical and ultrastructural studies. The effect of trifluralin on parasite proliferation was also analyzed. Parasites exposed to trifluralin showed ultrastructural alterations, i.e., formation in some cells of large, membrane delimited vacuoles, a decrease in the number of HRP-positive reservosomes, and, as concentration increased, bizarre shapes. Trifluralin-treated parasites had an average of a little more than one HRP-positive reservosome per parasite as compared to an average of five HRP-positive reservosomes per control parasite. There was no perceptible change in the morphology of either subpellicular microtubules or flagellar microtubules following treatments. Significant inhibition of proliferation was observed at trifluralin concentrations in excess of 100 µM, a considerably higher concentration than reported for *Leishmania* species and *Trypanosoma brucei brucei* by Chan et al (1993, 1994).

- 66 WILHELM, E., J. E. JOY, Marshall University, and C. C. SLEMP, West Virginia Division of Surveillance and Disease Control--Distribution of *Aedes triseriatus*, the mosquito vector of LaCrosse encephalitis, in West Virginia.

Although *Aedes triseriatus* (Say), the mosquito vector of LaCrosse encephalitis, has been collected from 49 of West Virginia's 55 counties over the past 5 years, the 146 human cases of LaCrosse confirmed since 1992 are confined to just 11 southern and central counties of the state. Not only is this mosquito species widespread, it appears with considerable frequency. For example, it has been found at 133 of the 557 collection sites statewide, ranking it fourth (behind *Anopheles punctipennis*, *Culex restuans*, and *Cx. territans*) in frequency of occurrence. *Aedes triseriatus* larvae are found primarily on shaded hillsides in tires that contain a decaying leafy substrate. Tires lying in the open sunlight seldom harbor *Ae. triseriatus* larvae unless surrounded by emergent vegetation. Given the statewide distribution of the vector species, and its relatively high rate of occurrence, it is not clearly understood why LaCrosse is so geographically confined. The West Virginia Bureau for Public Health has initiated a program to educate residents in affected LaCrosse counties about the importance of tire removal from their areas.

- 67 PATTON, SHARON,¹ J.J. ZIMMERMAN,² TANYA ROBERTS,³ C.T. FAULKNER,¹ V.R. DIDERRICH,¹ A.M. ASSADI-RAD,¹ P.R. DAVIES,⁴ and J.B. KLIEBENSTEIN,² University of Tennessee,¹ Iowa State University,² Economic Research Service,³ North Carolina State University⁴--Epidemiology of *Toxoplasma gondii* in hogs in the United States.

To assess the seroprevalence of *Toxoplasma gondii* in swine herds in the United States, sera collected in the National Animal Health Monitoring System survey of 412 randomly selected swine herds in 17 states and from market weight pigs in Tennessee and North Carolina were tested for *Toxoplasma gondii* antibodies by the Modified Agglutination Test using formalin fixed tachyzoites as antigen. Titers of 32 or greater were considered positive. Twenty percent (679/3472) of the sows tested were positive. Positive hogs were present in each state except Colorado. Prevalence ranged from 12% positive in Illinois, Minnesota, and Nebraska to 34% positive in Alabama and Tennessee and 36% positive in Wisconsin. Forty-seven percent (195/412) of the farms had a least one positive sow in the herd. Percentage of positive farms ranged from 22% and 23% in California and Nebraska to 73% and 74% in Alabama and Wisconsin, and 89% in Tennessee. In contrast, the seroprevalence in market weight pigs from Tennessee was 3.0% (12/437). In North Carolina the

seroprevalence in market weight pigs was 0.6% (13/2312), but the seroprevalence in sows was 19% with 39% of the farms with at least one positive sow. The role of pork as a major source of human toxoplasmosis remains conjectural. (Supported in part by The National Pork Producers Council).

- 68 CHEADLE, MARK A., DAVID S. LINDSAY, SARA E. ROWE, and BYRON L. BLAGBURN. Auburn University--Prevalence of antibodies to *Neospora caninum* and *Toxoplasma gondii* in horses from Alabama.

Protozoal myeloencephalitis (PME) is common in horses. *Neospora caninum* is a newly recognized cause of this condition in horses as well as abortion and neonatal neurological disease. *Toxoplasma gondii* and *Sarcocystis neurona* are other potential causes of PME in horses. In the present study, we used the indirect fluorescent antibody test (IFAT) to determine the prevalence of *N. caninum* and *T. gondii*-specific IgG antibodies in horses from Alabama. *Sarcocystis neurona* was not included in the study because the IFAT cross-reacts with other species of *Sarcocystis* in horses. Samples routinely submitted for equine infectious anemia testing to the C. S. Roberts State Veterinary Diagnostic Laboratory, Auburn, Alabama were used. Histories were available on many samples. Samples were considered positive if complete surface reactivity to tachyzoites was present. To date antibodies to *N. caninum* have been observed in 4% of serum samples and antibodies to *T. gondii* have been observed in 7% of serum samples. Results of this study indicate that exposure to *N. caninum* and *T. gondii* are common in horses in Alabama. The clinical significance of these findings are presently being determined.

- 69 LINDSAY, D. S., and B. L. BLAGBURN. Auburn University --Prevalence of *Toxoplasma gondii* and *Sarcocystis* spp. in white-tailed deer and other animals from Alabama

Toxoplasma gondii is an important protozoal parasite of humans, domestic and wild animals. *Sarcocystis* spp. are common in many animals. We examined the prevalence of these parasites in several wild and domestic animals living in Alabama. The modified direct agglutination test and/or acid-pepsin digestion with mouse inoculation were used to detect *T. gondii*. Acid-pepsin digestion with direct microscopic examination and/or histology were used to detect *Sarcocystis* species. Antibodies to *T. gondii* were found in 21 (39%) of 54 white-tailed deer; bradyzoites/sarcocysts were observed in 43 (62%) of 69 white-tailed deer. *Toxoplasma gondii* was isolated from 1 of 3 raccoons, while *S. kirkpatricki* was present in all 3. *Toxoplasma gondii* was isolated from 1 of 1 bobcats and 1 of 1 coyotes; *Sarcocystis* spp. was not seen in the tissues of either. Antibodies to *T. gondii* were present in 17 (74%) of 23 Lammas and in 3 (33%) of 9 Emus.

- 70 ANDERSON, LORAN C. Florida State University, Tallahassee, FL 32306 - Unique stomatal patterns among *Sideroxylon* taxa of the United States.

Stomata on leaves of *Sideroxylon* (Sapotaceae) are individually surrounded by large peristomatal rims which in some cases nearly hide the guard cells. Yarn-like cuticular striae border the peristomatal rims in most taxa, and when present the striae vary in quantity and configuration. Some species have small flecks of cuticular wax on the epidermis in addition to the striae. Stomatal density among the taxa appears to be inversely proportional to size of the stomatal apparatus. The 10 species of *Sideroxylon* (formerly placed in *Bumelia*, *Dipholis*, and *Mastichodendron*) can be distinguished fairly easily by their stomatal patterns. In fact, the patterns can be used to suggest species alliances and parentage of suspected hybrids.

- 71 JOHNSON, SHELLEY L. and KATHLEEN A. KRON. Wake Forest University--Hybridization of *Rhododendron* cultivars and natural species: a molecular study.

Deciduous azaleas (*Rhododendron* section *Pentanthera*) hybridize extensively in nature as well as in controlled, artificial crosses. Morphology can be used to discern if hybridization has occurred, but this becomes problematic especially if the two parents are similar morphologically. For this reason, the diagnostic use of DNA may serve as a useful mechanism to determine if hybridization has occurred and perhaps to estimate the parentage of a putative *Rhododendron* hybrid. As a related issue, the effect of including hybrids in cladistic analyses will be investigated. The region of DNA for analysis is the biparentally inherited ITS region of nuclear ribosomal DNA. Three study groups are under investigation: (1) controlled crosses between natural species in *Rhododendron* section *Vireya*, (2) controlled crosses between cultivar azaleas, and (3) a naturally occurring population of two southeastern U.S. azalea species which are

apparently undergoing hybridization on Stone Mountain, GA. For the Vireyas and the cultivars, the data suggests that hybrids can be identified based upon ITS sequences, and their parentage may be estimated, although the cultivar crosses are less clear cut. In the naturally occurring hybridization zone, the two putative parent species are not sufficiently different in ITS sequence, making it impossible to distinguish the hybrids from the parents.

- 72 WATSON, LINDA E., and TIMOTHY M. EVANS. Department of Botany, Miami University, Oxford, OH 45056 - Molecular systematics of Tribe Anthemideae (Asteraceae), based on chloroplast gene *ndhF*.

The Anthemideae is a tribe of approximately 109 genera and 1740 species. Some of the cultivated species include daisies, chrysanthemums, chamomile, and tarragon, among others. The most ecologically important member in North America is big sagebrush, which is the dominant species of the cold deserts of the Great Basin. However, most of the anthemid genera occur in the Old World, with the greatest concentration in the Northern Hemisphere. There are three major centers of diversity: the Mediterranean Region, the Tibetan Plateau, and the Cape Province of South Africa. Several taxonomic classifications have been proposed, with the most comprehensive one based on a cladistic analysis of morphological characters. We sequenced the 3' end of chloroplast gene *ndhF* in representative genera, to produce a molecular phylogeny of the tribe. Sequence divergence values among genera range from 0.2 to 7.9%. The resulting molecular phylogeny is incongruent with the morphological phylogeny, with little to no correspondence between clades and subtribes. However, there is strong concordance with biogeography. Several South African clades are basal to the entire tribe, probably representing multiple, relictual lineages. The Mediterranean clade is monophyletic and exhibits a pattern of recent and rapid radiation. The Asian clade is basal to the Mediterranean clade, but is internally unresolved. Many members in the tribe have reduced floral structures associated with breeding system modifications, which have probably resulted in convergent evolution. This has undoubtedly contributed to an inaccurate interpretation of homology of morphological characters, resulting in a poorly resolved morphological phylogeny. Therefore, the molecular phylogeny is probably a better hypothesis of relationships for the Anthemideae. We are in the process of examining additional genes and genomes to assess the reliability of the *ndhF* tree, and to further clarify relationships in the tribe.

- 73 HE, TAO AND ZACK E. MURRELL. Department of Biology, Western Kentucky University, Bowling Green, KY 42101 - Micromorphological studies of two problematic species of dogwoods (Cornus: Cornaceae).

The shrubby dogwoods are segregated into three sections within subgenus Thelycrania: section Thelycrania, section Bothrocaryum, and section Umbellicrania. Section Thelycrania contains 30 species with opposite leaves; section Bothrocaryum contains two species with alternate leaves; and section Umbellicrania includes a single species, C. peruviana, found in Central and South America. Cornus parviflora, a species found in Kwangsi and Kweichow Provinces, China, has traditionally been placed in section Thelycrania; however, analysis of inflorescence structure suggests that it should be placed in section Umbellicrania. Analysis of pollen structure using both SEM and TEM also appears to support a sister relationship of C. peruviana and C. parviflora. Based upon comparisons of inflorescence and pollen structure, these two species represent a relict distribution of a basal lineage of dogwoods. The distribution pattern for these sister species may be explained by the migration of the American member of this Laurasian species pair southward into South America after the uplift of the Isthmus of Panama in the late Miocene and Pliocene, three to six million years ago.

- 74 WERTH, CHARLES R.¹, LINGHE ZENG², AND W. VANCE BAIRD². ¹Dept. of Biological Sciences, Texas Tech University and ²Dept. of Horticulture, Clemson University - An enigmatic tetraploid *Eleusine* (Gramineae) discovered in South Carolina.

During a survey of genetic variability in goosegrass, *Eleusine indica*, plants closely resembling this species but differing in subtle ways were discovered in the vicinity of a cotton field in Calhoun County, SC. These plants were larger than *E. indica*, possessed larger seeds with smoother surfaces, and possessed pubescent rather than membranaceous ligules. These plants exhibited fixed heterozygosity at several isozyme loci, suggesting that they might be polyploid. Polyploidy was confirmed by flow cytometry indicating a DNA content of 3.8 pg and chromosome counts of 2n=36, both of these values being twice that for diploid *E. indica*. Three hypotheses could account for the origin and status of these plants: (1) they arose *in situ* from diploid *E. indica* via chromosome doubling; (2) they are referable to the African allotetraploid *E. africana*; or (3) they represent an undescribed allotetraploid species new to science. Neither morphology nor isozyme data are consistent with the tetraploid *E. indica* hypothesis, and these plants most likely herald introduction of a new taxon to North America. Morphological features support the *E. africana* hypothesis, while the unique isozyme profile suggests a new species. Additional evidence is being sought that can help discriminate between these hypotheses.

- 75 NELSON, JOHN B. Dept. of Biological Sciences, A. C. Moore Herbarium, University of South Carolina, Columbia SC 29208 - A problematic hedge-nettle (*Stachys*) from the coast of South Carolina.

Two different collections of an anomalous hedge-nettle (*Stachys*) on the outer coastal plain of South Carolina suggest a new species. The plants are perennial with well-developed, slender rhizomes, consistently white corollas, and copious short pubescence on the upper leaf surface which affords the leaves a velvety feel. The collections are separated by no more than about 12km (10mi), and are found within the drainage of the Santee River, one collection from Charleston County, the other from adjacent Georgetown County. Plants are immediately separable from other potentially present taxa: *S. aspera* Michx., *S. floridana* Shuttlew. ex Benth., *S. hyssopifolia* Michx., and *S. tenuifolia* Willd. The South Carolina plants present a morphology unknown elsewhere in the Southeast. However, they bear some resemblance to certain plants of Virginia and West Virginia, these rarely and sporadically encountered, that most closely resemble *S. pilosa* Nutt., a native North American species distributed from New England to Alaska, and through much of the Great Plains. Additional studies are likely to prove the South Carolina plants as a new species.

- 76 HAYNES, ROBERT R. AND C. BARRE HELLIQUIST. Dept. of Biological Sciences, University of Alabama, Tuscaloosa, AL 35487-0344 and Dept. of Biology, North Adams State College, North Adams, MA 01247 - Alismatidae of North America.

The Alismatidae is the only subclass of vascular plants that consists entirely of aquatic or marsh species. In North America, the Alismatidae consists of 13 families, 30 genera, and 112 species. The subclass consists of species with distributions restricted to one county to those that occur in the vast majority of counties or equivalent in North America. Representative species and their distributions will be presented and discussed. The present authors prepared all family treatments other than the Scheuchzeriaceae, which consists of only one species. The authors used a combination of extensive field work in the eastern half of North America, less extensive field work in the western half of North America, and an examination of 50,000+ specimens from 76+ herbaria situated throughout North America. Specimens were examined from at least one herbarium in every state of the United States, as well as at least one from every province of Canada except the Northwest Territories.

- 77 GUNN, BOB. The Drifting Seed, 120 White Squirrel Lane, Brevard, NC 28712 - The coco-de-mer, *Lodoicea maldivica* (Gmelin) Persoon (Arecaceae): a unique drift endocarp that became a legend.

For thousands of years the Indian Ocean currents brought rare, dead, gigantic endocarps to the coasts of India, Sri Lanka, Maldive Islands, and Java. Because of its unique shape, this endocarp became a prized, legendary alicorn. Some of them sold for the price of a fully-loaded ship. The history of this endocarp extends from 1519 through the discovery in 1746 of Praslin (Seychelle Islands) and the parent trees in the Vallee de Mai to the present day. The coco-de-mer is related to the Tree of Knowledge, through the writings of General Charles George Gordon. The life history of this borassoid palm is described, as well as the germination of its endocarp, containing the largest seed in the world.

- 78 STRATTON, LEWIS P.^{1,2}, MIKE KELLY², MARK C. MANNING², AND JOHN F. CARPENTER². ¹Biology Dept., Furman University and ²Dept. Pharmaceutical Sciences, School of Pharmacy, University of Colorado Health Sciences Center-Behavior of Proteins in Temperature Sensitive Gels

Recent advances in the development of protein and peptide based pharmaceuticals have increased the need for efficient and practical methods of stabilization and delivery. Pluronic® F127 (also known as poloxamer 407) is a polyoxyethylene-polyoxypropylene block copolymer that exhibits reverse gelling properties and its use as a vehicle for stabilization and delivery of low concentrations of various drugs including proteins has been reported. In the current study, protein concentrations in the range of 0.1 to 20 mg/mL were studied to determine the usefulness of this agent at much higher concentrations of protein than had been previously reported. We examined secondary structure and/or enzyme activity of several model proteins to determine the influence of Pluronic® F127 on these characteristics. The solubility of several proteins in 22% (w/w) Pluronic® F127 was determined and when protein concentration was above the solubility limit, a white microcrystalline precipitate formed without alteration in secondary structure or loss of enzyme activity.

- 79 PIVORUN, EDWARD B. Clemson University-Diadenosine tetraphosphate modulates dopamine metabolism via a P_2 receptor in PC12 cells.

Chromaffin cells and neurons store and release diadenosine tetraphosphate (Ap_4A). A neuromodulatory role for Ap_4A is suggested. PC12 cells (a clonal cell line derived from chromaffin cells) exhibit specific receptors for Ap_4A . HPLC with electrochemical detection was used to monitor the effects of extracellular Ap_4A on dopamine release and metabolism in PC12 cells. Ap_4A results in a selective dose dependent increase in extra- and intracellular levels of dihydroxyphenylacetic acid (DOPAC) and a decrease in intracellular levels of dopamine. The selective increase in DOPAC suggests that Ap_4A stimulates monoamine oxidase (MAO) activity. MAO inhibitors prevent the observed increases in DOPAC. PC12 cells preincubated with tyrosine kinase (genistein) and tyrosine phosphatase inhibitors (bromotetramisole and dephosphostatin) display attenuated responses to Ap_4A . In addition, stimulation of cyclic AMP production (forskolin) potentiates the response to Ap_4A and inhibition of cyclic AMP production (SQ 22536) inhibits the Ap_4A induced response. This study is the first to demonstrate that Ap_4A is a potent and rapid activator of MAO activity. Indeed, Ap_4A may be one of the few endogenous substances to activate MAO.

- 80 BLACKSTON, CHRISTIE R. AND JAMES B. CLAIBORNE. Georgia Southern University and Mount Desert Island Biological Laboratory -Messenger RNA transcripts for isoforms of the Na^+/H^+ antiporter (NHE) in the gills of a marine fish, the long-horned sculpin, *Myoxocephalus octodecimspinosus*.

Na^+/H^+ exchanger is found in the gills of marine fishes and is thought to be primarily involved with acid-base regulation. Northern blot analysis has shown that mRNA transcripts that are homologous to a cloned human NHE-1 isoform (Na^+/H^+ antiporter) are present in the gills of the long-horned sculpin. There are at least five known NHE isoforms present in vertebrates. The NHE-1 isoform is known to be involved in intracellular pH regulation by driving the efflux of H^+ for the influx of Na^+ . We speculate that in marine fish an antiporter homologous to NHE-3 is located on the apical side of gill epithelium. This transporter may aid in systemic pH regulation by secreting H^+ in exchange for external Na^+ . The goal of this research is to find the mRNA that codes for this exchanger and determine which NHE isoform(s) exist in the cell membrane of gill cells. We have found, using reverse transcriptase, polymerase chain reaction, and degenerate primers from conserved regions found in other vertebrate isoforms of NHE, a nucleic acid sequence in the mRNA from gill homogenate of the sculpin. This sequence is ~63% homologous to the β -NHE sequence found in trout cephalic kidney. Degenerate primers are also currently being used from conserved regions of published rat, rabbit, and human NHE-3 mRNA in an attempt to find sequences for this specific isoform in mRNA of the sculpin. Research supported by NSF RUI-94-19849 to J.B.C.

- 81 COLLINS, KRISTY R. AND GEORGE J. ARMELAGOS. Berry College and Emory University. The prevalence of tetracycline labeling in a Sudanese Nubian population (350-550 A.D.)

Thin-sections of bone taken from a Sudanese Nubian X-group population exhibit the characteristic yellow-green fluorescence of tetracycline when viewed under UV light. This study was undertaken to quantify the tetracycline ingestion of 55 irrigation agriculturalists who lived along the Nile in the area of what is now Wadi Halfa between 350-550 A.D. Thin-sections of the femur were hand-ground to 100 microns and viewed under fluorescence microscopy at 490 nm. Many osteons exhibited full fluorescence around the Haversian system, indicating that the individuals ingested tetracycline regularly during the 80 days required for osteon mineralization. The phenomenon of "feathering" (cases in which the osteon is incompletely mineralized and exhibits mottled fluorescence) indicated that some osteons were in the formative process at the time of exposure to tetracycline. Many of the labeled osteons are adjacent to unlabeled osteons, which indicated that the osteons were labeled *in-vivo*, as opposed to being labeled as a product of post-mortem factors. Of the 51,008 osteons sampled, 4499 (8.8%) were labeled with tetracycline. Of the 55 individuals studied, 53 (96.4%) had labeled osteons, and 36 (65.45%) exhibited "therapeutic" levels of tetracycline labeling--greater than 4.99%. A gender comparison showed 14 males to have an average of 10.8% of their osteons labeled, while 26 females have an average labeling of 8.3%. Future lines of study will involve investigation into putative benefits of tetracycline to individuals, and the peculiarity of the lack of development of antibiotic resistance by bacteria.

- 82 SPRATT, HENRY G., Jr., AND JAMES T. NEWBY, Jr. The University of Tennessee at Chattanooga - Isolation and characterization of soil bacterial cultures capable of growth on waste crankcase oil as a sole carbon source.

Bacterial cultures capable of utilizing used crankcase oil as a sole carbon source were isolated from soil samples known to have been exposed to waste oil over a long period of time. Surface soils (0 to 3 cm)

were collected from two different sites in the vicinity of Chattanooga, TN. Soils were transported to a laboratory where they were aseptically transferred to sterile basal salts medium plus surfactant and used crankcase oil (enrichment medium). The concentration of oil in the enrichment medium was 3.5 % (vol. basis). Soil suspensions were incubated at 25 °C, with vigorous shaking to provide aerobic conditions for growth. Cultures were transferred to fresh media after approximately one week of incubation. Cultures were transferred from these secondary enrichment broth cultures to enrichment media augmented with 2 % agar after evidence of growth was present. Colonies of the isolates were observed growing on the agar/oil plates within two to three days. From these colonies pure cultures were isolated by streaking to both tryptic soy agar and enrichment agar plates. Three different pure cultures were isolated. These cultures have been tentatively identified as belonging to the genus *Acinetobacter*, with one culture identified as *A. baumannii/haemolyticus*. Large differences were observed, qualitatively, in comparisons of growth of the three different oil utilizing cultures in enrichment broth cultures. Quantification of the degradation of oil by these isolates is currently underway. These cultures will be used to determine the effects of nutrient addition and different surfactants on the degradation of used crankcase oil. Potential for the use of these cultures in the clean-up of small-scale oil spills is being evaluated.

- 83 COGGIN, STEVEN J. Department of Biology, Catawba College, Salisbury, NC 28144 - The role of nutrient limitation and cell division pattern in yeast dimorphism.

Yeasts are single celled fungi that, under certain environment conditions, can produce filaments of cells called pseudohyphae. The conversion from yeast to pseudohyphal growth is a developmental change resulting in differences in cell shape, cell division pattern and colony morphology. This dimorphic transition is associated with pathogenicity caused by many plant and animal fungal parasites. The trigger for pseudohyphal growth in the budding yeast *Saccharomyces cerevisiae* is nutrient limitation. On complete medium *Saccharomyces cerevisiae* reproduces by budding division, but on both low nitrogen and low carbon media *Saccharomyces cerevisiae* forms chains of elongated cells. The fission yeast *Schizosaccharomyces pombe* divides by binary fission on complete medium but makes the transition to pseudohyphal growth on both nitrogen and carbon limited media. Colony morphology of yeasts grown on agar plates is also affected by the transition to pseudohyphal growth. On complete agar medium *Saccharomyces cerevisiae* forms round colonies with smooth margins. The perimeter of these colonies has a Euclidian dimension of one. Colonies of *Saccharomyces cerevisiae* grown on carbon or nitrogen limited agar medium have an irregular margin produced by growth of pseudohyphae. The perimeter of colonies on nutrient limited media have a dimension of about 1.2 and is an example of fractal geometry. *Schizosaccharomyces pombe* also produces round colonies on complete agar medium but makes colonies with fractal margins on both carbon and nitrogen limited media.

- 84 BARNETT, JASON, JAGAN V. VALLURI, AND H. WAYNE ELMORE. Department of Biological Sciences, Marshall University, Huntington, WV 25755 - Protein synthesis and ethylene biosynthesis in sandalwood callus cultures exposed to drought and heat shock.

Plant cell cultures exposed to environmental stress conditions synthesize a unique group of stress proteins. These proteins seem to play a role in protecting the plant cell. A knowledge of the molecular responses such as gene expression during cellular adaptation would be helpful and might lead to the identification of the altered putative genes. Sandalwood callus was maintained on Murashige and Skoog medium supplemented with 1 mg/L 2,4-D and 1 mg/L benzyladenine. A group of rapidly growing sandal calli were exposed to elevated temperatures ranging from 32°C to 45°C. Another group of calli were subjected to low water potentials ranging from -0.4 MPa to -2.5 MPa. Protein synthesis induced by heat shock and drought stress were assessed by SDS-polyacrylamide gel electrophoresis. After 48 h of exposure to stress, a 30% reduction in callus volume was observed in both groups of calli. *In vivo* labeling of stressed tissue with ³⁵S-methionine revealed a diverse array of low molecular weight proteins on SDS-PAGE gels at 36, 40 and 45°C after 6 to 8 hours of heat shock. Although most appeared to be synthesized only during heat shock, some were detectable at low levels in control tissue. Measurements of ethylene precursors ACC and MACC levels in heat shocked tissues were used to determine changes in ethylene biosynthesis. ACC levels increased as the cells were exposed to higher temperatures of 36° and 42°C. It has been observed that MACC does accumulate when high rates of ACC synthesis was induced by elevated temperature.

- 85 J. Kenneth Shull, Jr. Department of Biology, Appalachian State University, Boone, NC 28608
Chromosome pairing in the interspecific hybrid *Lilium* X 'Black Beauty'.

The interspecific lily hybrid, *Lilium* X 'Black Beauty', is thought to be a hybrid of *L. henryi* and *L. speciosum*. This hybrid is sterile, and the cause of the sterility is a failure of chromosome pairing in meiosis I. The diploid chromosome number is 24 (as in all but one species of *Lilium*.) but the number of

bivalents seen in metaphase I has been reported ranging from 0 to 5. Chromosome pairing in colchicine-induced amphidiploids is normal with 24 bivalents. The supposition is that pairing in the diploid 'Black Beauty' is non-homologous. The chromosomes of *Lilium* are very large and can easily be divided into three groups, two large and metacentric, seven of moderate size and acrocentric, and three small and acrocentric. In this study the type of chromosome pairing was addressed. If the pairing is truly random then pairing between large and medium, large and small, and medium and small chromosomes should be random. If, however, the chromosomes preferentially pair with their homeologues, then more large-large, medium-medium, and small-small pairing should be evident, even if the individual chromosomes are not distinguishable. In diakinesis it was found that (a) more pairing than 0-5 bivalents were present and that (b) the pairing was predominately between like-sized chromosomes. In metaphase I there were fewer bivalents but the pairing remained mostly between like-sized chromosomes. These results indicate preferential pairing between homeologous chromosomes. Statistical analysis and analysis of chromosome aberrations in anaphase I and II are in progress.

- 86 PITILLO, J. DAN¹, STANLEY W. BUOL², and ROBERT D. HATCHER³. ¹Western Carolina Univ., Cullowhee, NC. 28723; ²North Carolina State Univ., Raleigh, NC 27695; and ³The Univ. of Tennessee, Knoxville, TN 36996-1410 & Oak Ridge Nat. Laboratory, Oak Ridge, TN 37831 - Introduction to the vegetation and environment of the Southern Blue Ridge Province.

The Appalachian Blue Ridge (BR) is composed of ancient rocks, but the topography is relatively young and relict of a much more extensive mountain range. The southern portion of this province extends south from Virginia to Alabama and separates the Piedmont (P) and Valley and Ridge (VR) of the Carolinas, Tennessee, Georgia, and Alabama. Rocks of the BR represent ancient origins that were overthrust in the central BR and metamorphosed during a collision with Africa. Present topography and climate are probably relicts of the Pleistocene climate (both glacial and interglacial), rock type distribution and, only to a lesser extent, ancient bedrock structure, influences of Blue Ridge vegetation, and soils. The overwhelming feature characterizing the BR today is its dynamic chemical weathering that yields weakly developed, acidic soils over saprolite horizons on the steep slopes that support a predominant acid-loving vegetation, especially heaths. Equally acid soils with more clayey subsoils form in thick colluvial deposits on more stable lower slopes. Most soils have a udic soil moisture regime with perudic conditions to the south. A mesic soil temperature regime with frigid temperatures at highest elevations coupled with the adequate summer moisture provides habitats for many of the relict plant species and unique temperate vegetational combinations on these relatively infertile soils.

- 87 MEIER, ALBERT J.¹, AND SUSAN P. BRATTON². ¹Dept. of Forestry, University of Missouri-Columbia, Columbia, MO 65211 and ²Lindamon #1104, Whitworth College, Spokane, WA 99251 - Environmental factors associated with occurrence of vernal herbs in the southern Appalachians.

A survey of 21 species of vernal forest herbs recording presence and density estimates in more than 800 90m by 90m plots was performed in the northern half of Great Smoky Mountains National Park. Of the 21 species analyzed, 11 species were significantly more likely to occur in primary forest plots than in secondary forest plots. Two species occurred more frequently in secondary plots. Four species occurred more frequently at low altitudes, eight species occurred more frequently at mid-altitudes, and one species occurred more frequently at high altitudes. Thirteen species were more frequent in areas with less than 25% rhododendron cover, no species were more frequent where 25% or more of the plot was covered with rhododendrons. No species occurred more frequently on convex slopes, while two species occurred more frequently on flat slopes, and 14 species occurred more frequently on concave slopes. Species with a higher fidelity to Appalachian sites appear to be more sensitive to disturbance.

- 88 FELS, JOHN E. AND THOMAS R. WENTWORTH. Department of Landscape Architecture and Department of Botany, North Carolina State University - Predictive Mapping of Potential Natural Vegetation in the Southern Blue Ridge: a prototype study in the Ellicott Rock National Wilderness.

Predictive vegetation mapping uses statistical models of vegetation-environment relationships to support the spatial simulation of potential vegetation patterns. Vegetation response models are formulated as relationships between observed species responses at specific locations and sets of predictor variables associated with those locations. Predictor variables can be derived from a multi-attribute digital terrain model, which also serves as the basis for simulating vegetation responses in the subject landscape. The results of these procedures are maps of potential species abundances and distributions manifest as responses to terrain variation. We used this approach to map the potential distributions of twenty-seven vascular species in a national wilderness area in the Southeastern Escarpment region of the Southern Blue Ridge. Patterns of species distributions were distinctly divided between xerophytic and mesophytic responses in this environment, yet each individual distribution revealed specific nuances of response. For one species, predicted distributions even reflected the influences of a regional pathogen. Our approach, while strongly reliant on suitable terrain metrics as predictor variables, is capable of producing detailed simulations of biospatial patterns. Such an approach might be successfully applied to other study areas where terrain variation is an important determinant of vegetation patterns.

- 89 ZARTMAN, CHARLES E. AND J. DAN PITTILLO. Dept. of Biology, Western Carolina University, Cullowhee, NC 28723 - A unique component of gorge vegetation: The spray cliff communities of the Chattooga River Gorge.

Spray cliff communities are best developed along the steep gorge walls of the southern Blue Ridge Escarpment, and they consist of an assemblage of plant species unique to the southern Appalachians. A quantitative vegetation survey of spray cliffs was conducted in the Chattooga Gorge, a watershed which drains the western boundary of the escarpment, in an effort to better understand the relationship between spray cliff community structure and six environmental variables. A total of 300 vascular and nonvascular plant species, 41 of which represent southern Appalachian endemics, were documented at 37 spray cliff sites. Although 32% of the spray cliff plant species are rock outcrop restricted, 38% percent of the commonly occurring species tolerate a wide range of habitats. The weak linear relationship between species recurrence and mean coverage suggests that individual study sites support a unique suite of dominating plant species. Results from gradient analytical techniques indicate that elevation and spray cliff area were strong predictors of species composition. A strong correlation also existed between plant richness and spray cliff area. The notably steep plant richness-area curves accompanied by the area's strong influence over vegetation suggests that certain physical factors governing spray communities parallel those associated with oceanic island systems.

- 90 SMALL, CHRISTINE J. and THOMAS R. WENTWORTH. Dept. of Botany, North Carolina State University - Characterization of Montane Cedar-Hardwood Woodlands in the Southern Blue Ridge Province.

Montane Cedar-Hardwood Woodlands, *Juniperus virginiana*-dominated plant communities, occur on steep south-facing rock outcrops in the southern Appalachian Mountains. Because the vegetation and environmental relationships of these communities are poorly understood and their position along regional gradients is unclear, an intensive study of the Woodlands was conducted. Permanent 0.1 ha plots were established in the southern Blue Ridge Province of North Carolina to characterize quantitatively the vegetation, dynamics, and environment of the Woodlands. Patterns of compositional similarity were explored among sample plots using cluster analysis to segregate plots and identify species and site conditions most effective in characterizing this community type. Gradient analysis was used to explore environmental relationships among plots and to better understand the relative position of the Woodlands along regional compositional and environmental gradients. Common Woodland canopy species included *J. virginiana*, *Carya glabra*, *C. alba*, and *Quercus montana*, with a rich herbaceous layer dominated by *Schizachyrium scoparium*, *Andropogon gerardii*, *Sorghastrum nutans*, and *Carex* spp. Basophilic species such as *Dodecatheon meadia* and *Amelanchier sanguinea* were also common. Detrended Correspondence Analysis of Woodland plot data with southern Appalachian regional data suggested greatest compositional similarity of Woodlands to sites of lower elevation and fertility in the Blue Ridge Escarpment.

- 91 NEWELL, CLAIRE L. AND ROBERT K. PEET. Dept. of Biology, University of North Carolina, Chapel Hill, NC 27599-3280 - Vegetation of Linville Gorge Wilderness.

Linville Gorge Wilderness is a rugged, 600 m deep valley that cuts through the Blue Ridge Escarpment on the eastern edge of the Southern Appalachian Mountains. Vegetation of the wilderness was sampled using a nested quadrat method. Species composition and abundance were analyzed using cluster analysis to identify the major vegetation communities. Detrended Correspondence Analysis was used to determine the distribution of communities in relation to topographic and edaphic variation. Sites were distributed across gradients of soil fertility, soil texture, topographic position and geology. Heath-dominated *Quercus montana* communities inhabit the upper-slopes, with communities dominated by *Pinus pungens* and *P. rigida* on infertile, exposed ridge lines. *Quercus* forests lacking an evergreen heath dominate south-facing, mid- and lower-slopes. *Tsuga* species and *Pinus strobus* with an evergreen heath occupy the steep, lower-slopes of the gorge. Upper-slope ridge lines underlain by phyllite are dominated by species-rich *Carya* forests. Rare and disjunct species are concentrated on rock outcrops on the eastern rim of the gorge. Overall dominance of *Quercus montana* and presence of spatially restricted ecosystems and species set this wilderness apart from most of the southern Appalachian Mountains, reflecting in part low rainfall, predominantly acidic bedrock and lack of anthropogenic disturbance.

- 92 WENTWORTH, THOMAS R. and CHRISTOPHER J. ULREY. Dept. of Botany, North Carolina State University, Raleigh, NC 27695-7612 - Vegetation of the Thompson River watershed, North and South Carolina.

The Thompson River drains a 35 km² watershed on the southeastern Blue Ridge escarpment, from its headwaters near Cashiers, North Carolina to its terminus at Lake Jocassee, South Carolina. Elevations in this highly-dissected, mountainous landscape range from 340 to 1340 m. 150 0.1 ha plots were established in 1976-1978 to characterize natural vegetation and environment throughout the watershed. Percentage cover data for all vascular taxa were obtained from visual estimates (herbaceous plants, shrubs, and tree seedlings) or from models predicting cover of trees from stem diameter data. Cover data were analyzed by clustering to identify community classes and by ordination procedures (detrended correspondence analysis, non-metric multidimensional scaling, and canonical ordination) to determine relationships of vegetation to environment.

Community classes recognized are indicative of a highly disturbed landscape transitional between the interior mountains and the upper Piedmont. Vegetation patterns are most strongly associated with gradients of topographic-moisture and soil nutrients and secondarily with elevation.

- 93 PATTERSON, KAREN D.¹, THOMAS R. WENTWORTH², J. DAN PITILLO³, AND ROBERT DELLINGER⁴. ¹The Nature Conservancy, Chapel Hill, NC 27515, ²North Carolina State University, Raleigh, NC 27695, ³Western Carolina University, Cullowhee, NC 28723, ⁴Great Smoky Mountains National Park, Gatlinburg, TN 37738 - Classification of vegetation in Ellicott Rock Wilderness, Southeastern Blue Ridge Escarpment.

Ellicott Rock Wilderness (ERW) is a 3400 hectare forest preserve that lies at the juncture of North Carolina, South Carolina, and Georgia in the southeastern portion of the Blue Ridge escarpment, southern Appalachian mountains. Fifty-seven permanent, one-tenth hectare plots were established in ERW using methods developed by the North Carolina Vegetation Survey. Data from 54 sample locations were analyzed using clustering, indirect ordination, and correlation methods and a floristic classification recognizing eight forest types was developed. Vegetation patterns were related to site, landscape, and soil characteristics at local scales and also placed within a regional classification framework. Analyses of complete floristic data and environmental information suggest that vegetation patterns in ERW are controlled by complex gradients related to elevation, exposure, and soil nutrient status, thus qualitatively validating historically recognized patterns in the southern Appalachian Mountains.

- 94 ROBERTS, STEPHEN D.¹, J. DAN PITILLO¹, THOMAS R. WENTWORTH², CHARLES ZARTMAN¹, AND CHRIS ULREY². ¹Dept. of Biology, Western Carolina University, Cullowhee, NC 28723, ²Dept. of Botany, North Carolina State University, Raleigh, NC 27695 - Classification of old-growth communities of the Kelsey Natural Area, Southern Blue Ridge.

The Kelsey Natural Area is a 105 ha US Forest Service tract of the original "Ravenel Woods" located near the Blue Ridge divide east of Highlands, North Carolina. Eighteen permanent plots were classified by cluster analysis of percentage cover data into eight community types: Canada Hemlock Forest, Acidic Cove Forest, High Elevation Granitic Dome, Carolina Hemlock Bluff, Pine-Oak Heath, Chestnut Oak Forest, Montane Oak-Hickory Forest, and Successional White Pine Forest. Analysis of these data by detrended correspondence analysis revealed compositional trends that were most strongly associated with soil pH, landform protection, and slope sectional curvature. Data from this project were also combined with those from a similar study in the Ellicott Rock Wilderness to determine relationships of communities identified in the Kelsey Natural Area with those from a larger landscape on the nearby Blue Ridge escarpment.

- 95 PEET, ROBERT K.¹, GARY KAUFFMAN², CLAIRE L. NEWELL¹, J. DAN PITILLO³, MICHAEL P. SCHAFALÉ⁴, ALAN S. WEAKLEY⁵, AND THOMAS R. WENTWORTH⁶. ¹University of North Carolina at Chapel Hill, ²U.S. Forest Service, ³Western Carolina University, ⁴North Carolina Natural Heritage Program, ⁵The Nature Conservancy, ⁶North Carolina State University - Vegetation of the Nantahala Mountains, North Carolina.

As part of a larger study of the natural vegetation of southern Appalachian Mountains, we sampled 89 sites representative of the range of natural vegetation of the Nantahala Mountains. As with other regions of the southern Appalachians, elevation, moisture and soil fertility gradients explained much of the local variation in vegetation. However, the Nantahalas generally have more fertile soils than most other Southern Appalachian ranges and consequently have a greater representation of and range of variation in rich cove forests, but fewer examples of acidic cove and slope forests (both oak- and hemlock-dominated types). Cove forests over amphibolite and marble in the Nantahala region are among the most fertile in the southern Appalachians and have a significant depression of herb diversity owing to competition among the herbs for light. The savanna-like vegetation over olivine at Buck Creek represents the best and most extreme example of vegetation on ultramafic rocks known in the Carolinas. The distinctiveness of the Nantahala vegetation when compared with that of the five southern Appalachian study regions described by Newell et al. further underscores the geographic variation among these landscapes and the dangers implicit in extrapolating from one portion of the southern Appalachians to another.

- 96 WHITE, PETER S.¹, MARK D. MACKENZIE² AND JONATHAN HARROD¹. ¹Ecology Curriculum, University of North Carolina, Chapel Hill, NC 27599-3280 and ²School of Forestry, Auburn University, Auburn, AL 36849-5418. - The vegetation of Great Smoky Mountains National Park: sources of landscape variation as seen in the Miller data set (1935-1937)

Soon after the establishment of Great Smoky Mountains National Park in 1934, the National Park Service employed Frank H. Miller to survey the park's vegetation. Miller's crews sampled 1,378, 0.08 ha plots (950 of forest vegetation) across approximately 2,000 km². Though the park has been heavily studied, this remains the largest and most spatially extensive survey ever carried out. Further, the sampling took place at an important time: American chestnut, although dying in large numbers, was a forest dominant, and some

watersheds were in the early stages of recovery from pre-park and very exploitive logging. Miller's crews recorded approximately 20,500 live trees (>10 cm dbh) of 55 species. Until computerization in the 1980s at the Uplands Field Research Lab, this data set had never been analyzed or described. The extensiveness of the data set revealed interesting geographic patterns: chestnut was a dominant of North Carolina watersheds, hemlock reached its highest dominance in the eastern portion of the park, and pitch pine reached its highest dominance in the western part of the park. We will discuss the Miller data set in the context of more recent work.

- 97 DELCOURT, PAUL A. AND HAZEL R. DELCOURT. Dept. of Ecology & Evolutionary Biology, University of Tennessee, Knoxville, TN 37996 - Prehistoric pyromaniacs in the southern Appalachian oak - chestnut forest region.

Fossil pollen assemblages and charcoal particles are preserved in peat deposited during the past 3900 calendar years within Horse Cove Bog, located near Highlands in Macon County, western North Carolina. These paleoecological data demonstrate that prehistoric Native Americans used fire to expand and maintain open forests of oak (*Quercus*) and chestnut (*Castanea dentata*) with an understory of grass (Poaceae) and bracken fern (*Pteridium aquilinum*) in the southern Blue Ridge mountains. Indian-set fires promoted both grassy balds and stands of pine (*Pinus rigida*, *P. pungens*) on ridgetops. North-facing, lower slopes with mesic cove hardwood forests probably escaped preColumbian fires in this temperate highland region of high annual precipitation (>200 cm). Aboriginal use of fire was concentrated in alluvial bottomlands near prehistoric human settlements as well as along upper hill slopes and mountain summits, sites important to prehistoric Native Americans for crop cultivation, for hunting of game, and for gathering of nuts. In the southern Blue Ridge, where lightning-set fires rarely occur as natural disturbance agents, we speculate that prehistoric Native American use of fire would have served as an intermediate-scale disturbance regime that would have heightened ecotonal contrast across plant community boundaries and would also have increased biodiversity across the preColumbian landscape in the southern Appalachian oak-chestnut region.

- 98 HARROD, JONATHAN¹, PETER S. WHITE¹, AND MARK E. HARMON². ¹Curriculum in Ecology and Dept. Biology, The University of North Carolina at Chapel Hill and ²Dept. of Forest Science, Oregon State University - Changes in xeric forests in western Great Smoky Mountains National Park, 1936-1995.

Upper slopes and ridges in the western Smokies burned frequently in the nineteenth and early twentieth centuries. Since the 1930's, the National Park Service has suppressed fire. This study documents changes in forest composition and structure using plot data from 1936-37, 1977-79, and 1995. Between 1936-37 and 1977-79, basal area and canopy density increased and *Castanea dentata* disappeared from the forest canopy. Between 1977-79 and 1995, basal area and canopy density remained relatively stable. On sites not burned since the early twentieth century, overall sapling density decreased, as did sapling densities of *Pinus virginiana*, *Pinus rigida*, and *Quercus montana*. Density and basal area of *Pinus strobus*, *Acer rubrum*, and *Tsuga canadensis* increased. These species, sensitive to fire when small, have grown into fire-resistant size classes. While abundant regeneration of *Pinus virginiana* and *Pinus rigida* has occurred on sites burned in the 1970's, overall abundance of these species will continue to decline under the current fire regime.

- 99 BUSING, RICHARD T. Forestry Sciences Laboratory, Pacific Northwest Research Station, Corvallis, OR 97331 - Structure and dynamics of cove forests in the Great Smoky Mountains.

From 1987 to 1992 seven stands of old growth and two agricultural stands were mapped as nine permanent plots (typically 0.6-1.0 ha) within coves of the northeastern Great Smoky Mountains. Long-term data were obtained from: 1) second-growth stands at Long Branch (1935-1993), 2) old-growth stands at Long Branch (1935-1988), and 3) an old-growth stand at Dunn Creek (1962-1992). The Long Branch site provided the opportunity to compare forest structure and dynamics between second-growth and old-growth stands. Other old-growth study stands were near Roaring Fork and Porters Creek. Old-growth sites had higher levels of stand biomass, woody debris volume, snag density, species equitability, tree size diversity, and gap size diversity. Second-growth stands had higher levels of NPP, mortality, stem density and tree species richness. Over several decades, marked changes were apparent in the composition, structure and diversity of second-growth stands, but not of old-growth stands. Small-scale (<0.1 ha) patch dynamics were inferred from the small patches formed by gap disturbances and by intraspecific aggregations in old-growth stands. Although these individual patches may have changed rapidly, stand-level changes were gradual in the old stands. Thus the patch dynamics concept of a shifting-mosaic steady-state seems appropriate. Whether a true steady-state has existed at any spatial scale in old-growth cove forests is an unresolved issue, however.

- 100 BRATTON, SUSAN P.¹, AND ALBERT J. MEIER². ¹Lindamon #1104, Whitworth College, Spokane, WA 99251 and ²Dept. of Forestry, University of Missouri-Columbia, Columbia, MO 65211 - Disturbance dynamics of the Chattooga River watershed.

Examination of U.S. Forest Service records, historical records, tree rings, and the modern landscape reveals changes in frequency and distribution of fire along elevation and moisture gradients through time in the

Chattooga River Watershed. Distributions of lightning-caused and anthropogenic fires differ spatially and temporally. Large-scale wind disturbances and natural ignitions are more frequent in southern and lower elevation portion of the watershed. Historical records and composition of presettlement forests suggest extensive use of fire by Cherokee Indians in the lower portion of the watershed during the 18th century. The disturbance history influences floristic gradients between the Piedmont and the Southern Appalachians.

- 101 PEARSON, SCOTT M.¹, ALAN B. SMITH¹, AND MONICA G. TURNER². ¹Biology Dept., Mars Hill College, Mars Hill, NC 28754 and ²Dept. of Zoology, Univ. of Wisconsin, Madison WI 53706 - Forest fragmentation and patterns of plant diversity in western North Carolina.

Habitat fragmentation is thought to affect populations and communities by demographically isolating remnant populations and by introducing "edge effects" that may alter habitat suitability. The size of forest patches is related to historical land uses which affect present-day communities. We studied the effects of fragmentation and land use on cove forest communities. This research has revealed that the area of a forest patch is correlated with the composition in its herbaceous plant community. Small patches have a larger component of edge species. Smaller patches also have reduced diversity and abundance of forest-interior species which generally thrive in moist, shady, undisturbed microsites. The effects of patch size on forest-interior species could be produced by any of the following mechanisms: (1) Small patches have smaller, isolated populations and suffer higher probabilities of local extinctions. (2) Edge species compete with forest-interior species for limiting resources. (3) Smaller patches have been disturbed by humans more frequently and more intensely than larger patches. Differences in disturbance history are evident in soil carbon storage. Our present research seeks to determine which mechanisms are responsible for the observed patterns and to link them to ecosystem processes such as soil formation and carbon storage.

- 102 WILDS, STEPHANIE P.¹, C. REED ROSSELL, JR.², AND IRENE M. ROSSELL¹. ¹Environmental Studies Program, University of North Carolina at Asheville, NC 28804 and ²Dept. of Environmental Studies, Warren Wilson College, Swannanoah, NC 28815 - Avian species composition, landscape diversity, and vegetation structure in a partially disturbed Southern Appalachian forest-gap bog complex.

Avian species composition is influenced by vegetation structure, composition, and successional stage, and by landscape structure and heterogeneity, especially on a local scale. In this study, we applied spatial analysis using a geographic information system (GIS) in examining bird species abundance and diversity, vegetation structure, and landscape patchiness in a Southern Appalachian forest-gap bog complex. This 94 ha Graham Co. site, known as Tulula Bog, represents one of the few remaining examples of this rare community type. In the past decade it experienced partial disturbance (clearing and grading) as a result of an unsuccessful golf course development project and is now in the early stages of restoration. Using data from three breeding bird surveys conducted in 1994, we determined that this site supports a diverse avian community, including several uncommon Neotropical migrants. Species were evenly divided between interior and edge species, despite a high degree of landscape fragmentation. Avian abundance and diversity decreased with increasing distance from water features and associated riparian vegetation. This study establishes baseline data to assess future restoration activities, and to assess the present conservation value of the site in the context of regional avifaunal management activities.

- 103 FAITH, SHEILA C. AND GWENDA L. BREWER. Frostburg State University, Frostburg, MD 21532- Effects of water fluctuations on egret interactions.

Chincoteague National Wildlife Refuge on the Eastern Shore of Virginia conducts seasonal drawdowns in their freshwater impoundments to provide habitat for migratory waterfowl. This practice may have a detrimental effect on other wildlife, such as waders, that use the impoundments. To determine the effects of this water management on waders, interactions and foraging behavior were recorded for Great Egrets (*Ardea alba*) and Snowy Egrets (*Egretta thula*) between May 30 and August 22, 1996. Egrets fed individually and in mixed flocks that ranged from 2-200+ birds. Five impoundments were chosen and observed at dawn and dusk. Prey items were categorized into seven basic categories: mammal, bird, reptile, amphibian, fish, invertebrate, and unknown. Aggressive interactions were classified as supplanting others, chasing others, and stealing food. Preliminary data suggest that fish, especially American Eel (*Anguilla rostrata*), were the most common prey. Egrets aggressively defended feeding territories from conspecifics, but rarely from other herons and egrets. In larger groups which formed when water drawdowns occurred, there appeared to be a reduction in defense. Aggregations and aggressive interactions were disrupted by Hurricane Bertha in July as water levels increased and birds dispersed.

- 104 KING, ANTHONY W., TOM L. ASHWOOD, VIRGINIA H. DALE, AND LINDA K. MANN. Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN - On the persistence of red-cockaded woodpecker, *Picoides borealis*, in the southeastern United States.

The red-cockaded woodpecker (RCW; *Picoides borealis*) is an endangered species endemic to mature pine forests of the southeastern United States. Fire management, deforestation, forestry practice, and other changes in land use have reduced and fragmented the once extensive pine savannah habitat preferred by RCW. Remaining populations of RCW are small, isolated, and fragmented. Isolation and fragmentation may have negatively impacted juvenile dispersal and contributed to the species decline throughout the Southeast. We use a series of metapopulation models to address this question and to assess the regional persistence of RCW. We address two questions: (1) is the current distribution of RCW habitat across the Southeast consistent with long-term persistence of the regional metapopulation, and (2), if not, what changes in habitat distribution or other management interventions (e.g., translocation to subsidize interpopulation dispersal) are needed to ensure regional persistence.

- 105 RITLAND, DAVID B. Dept. of Biology, Erskine College, Due West, SC 29639 — Dual mimicry in the viceroy butterfly: A tale of two models.

The most familiar type of defensive mimicry involves a defenseless prey species (the mimic) that gains protection from predators through its resemblance to a protected prey species (the model). A premier example of mimicry is the Viceroy butterfly (*Limenitis archippus*), well known as a superb mimic of the chemically defended Monarch (*Danaus plexippus*). However, viceroy populations in both the southeastern and southwestern U.S. appear to have "switched" phenotypically from mimicking the Monarch to mimicking two subspecies of a darker and less-defended model, the Queen (*Danaus gilippus*). Combining field censuses, computerized wing-color analysis, and laboratory predation studies, I provide evidence supporting this "model-switching" hypothesis. Specifically, in the southeastern U.S., a latitudinal cline in viceroy wing color is correlated with a latitudinal shift in relative abundance of Monarchs and Queens, and laboratory studies suggest that a selective advantage accrues to viceroy phenotypes that more closely mimic the locally predominant model. Thus, the viceroy's mimetic wing-color pattern appears to be regionally "fine-tuned," phenotypically tracking different models in different areas.

- 106 BROOKS, JANIE S AND PAUL FEENY Section of Ecology and Systematics, Cornell University, Ithaca, NY 14853 - Chemical signals on *Daucus carota* leaf surfaces: keys of recognition for the black swallowtail butterfly, *Papilio polyxenes*

Ovipositing insects generally make final host-selection decisions based on compounds present on the leaf surface. Ovipositing females need to obtain certain types of information about the plants on which they land: information on plant identity (host or nonhost), leaf chemistry (levels of deterrents or toxins), and nutritional value. Leaf-surface chemistry has the potential to provide this information. Little is known about the chemistry of leaf surfaces and how variation in surface-chemical profiles influences host selection by insects. This work focuses on the leaf-surface chemistry of a single plant species (*Daucus carota*) with particular reference to compounds already identified as oviposition stimulants for one of its specialist insect herbivores (*Papilio polyxenes*). Carrot leaf surfaces were extracted with chloroform and near-boiling water, and the resulting extracts fractionated and analyzed using high performance liquid chromatography. This talk will describe a study of the oviposition preferences of *P. polyxenes* females for domesticated carrot varieties and the extent to which leaf-surface chemical variation is correlated with these oviposition preferences.

- 107 DRANEY, MICHAEL L. Savannah River Ecology Laboratory, Aiken, SC 29802. - Diversity of ground-dwelling spiders from eight South Carolina inner coastal plain habitats.

A one-year sampling protocol was conducted to examine the diversity and phenology of ground-dwelling spiders at eight habitats on the Savannah River Site, South Carolina. Habitats sampled were an old field; young, medium, and mature pine plantations; a xeric scrub oak-pine stand; upland and riparian hardwoods, and a riparian old-growth forest. At each site, ten pitfalls were operated continuously for one year, and emptied biweekly. Additionally, ten 0.04 m² litter samples were taken from each site at bimonthly intervals. After removing arthropods, the litter and woody debris in each sample were dried and weighed. Over 250 species of spiders from 34 families were collected. Although the two sampling methods yielded distinctly different relative abundances of species, both methods showed similar patterns of spider diversity among habitats. Riparian habitats showed the highest diversity at the species and family levels; the old field/pine transitional habitat

contained fewer families but included species characteristic of both forests and fields. Spider abundance is correlated with amount and depth of litter whereas species- and family-level richness is correlated with abiotic conditions, with more mesic and less extreme habitats supporting families and species not found elsewhere.

- 108 MILLER, LUITPOLD E. Appalachian State University - Daily activity patterns, habitat preference, and home range geometry of two species of scorpions, *Centruroides vittatus* and *Diplocentrus sp.*

The ecology of scorpions is one of the least studied areas of scorpion biology. Two sympatric species of scorpions were studied in four different habitats within Big Bend National Park, Texas, in order to establish habitat preference, surface activity, and home range. Each location consisted of a 1000 m² plot that was sampled at random intervals from May 1996 to August 1996. This study is designed to establish correlations between certain environmental conditions and the number of surface-active scorpions. Preliminary data suggests that environmental factors such as moon light intensity, soil moisture, surface temperature, air temperature, and humidity greatly affect the activity of scorpions. Comparisons of the four habitats suggest that these scorpions have distinct habitat preferences. Preliminary home range was established for *Centruroides vittatus* by means of a mark and recapture study.

- 109 PACK, KARI J. Dept. of Biology, Appalachian State University, Boone, N.C. 28608 - Effects of *Toxocara canis* on the secondary sex ratio of *Mus musculus*.

Female mice, *Mus musculus*, were infected with the ascarid parasite *Toxocara canis* and then mated in order to see the effects of a parasite load on the secondary (at birth) sex ratios. The three experimental groups were infected with 300, 600, and 1200 *T. canis* ova, respectively, by stomach tube. The control animals were given a solution with no ova. Three days after infection all mice were mated. Pups were sexed and weighed at birth and again at weaning (21 days). The control and 300 groups produced sex ratios of approximately 50% males. The 600 and 1200 groups tended to produce a lower proportion of males. The weights of male pups at birth tended to be lower in the 600 and 1200 groups. These results are ambiguous with respect to adaptive variation of parental investment.

- 110 BRANNON, M. PATRICK AND R. WAYNE VAN DEVENDER. Appalachian State University, Boone, NC - Effects of microhabitat on shrew distributions.

Shrews are thought to be important, keystone predators in many forest communities. They feed voraciously and almost continuously on a wide array of invertebrates and small vertebrates. While previous studies suggest a relationship between shrew abundance and environmental moisture, relatively little is known about how other environmental factors influence microgeographic distribution and/or abundance of individual shrew species. To examine this problem, twelve 50x50 m plots were established in the Pisgah National Forest, Burke County, NC. Three plots were located in each combination of north and south slope with and without a nearby stream. Triradiate drift fence arrays with four pitfalls were placed near the center of each plot and opened monthly from summer 1996 through summer 1997. Four species of shrews (*Sorex cinereus*, *S. fumeus*, *S. hoyi*, and *Blarina brevicauda*) were captured. Pitfalls also collected representatives of prey (including arthropods, annelids, mollusks, salamanders, and small rodents) for comparison of shrew diet and prey availability in the different plots. Preliminary data show more shrews per trapping interval on north facing slopes and no effect of stream availability. Correlations of shrew diversity and abundance with microhabitat variables such as temperatures, vegetation, leaf litter depth and moisture content, and number and decay class of logs in each plot may provide some insight into ecological factors regulating shrew populations.

- 111 MAMMONE, KAREN A. AND RONALD E. BARRY. Frostburg State University - Small mammal assemblages in structurally diverse clearcuts and adjacent woodlands in western Maryland.

Small mammal responses to four different structural classes of clearcuts and adjacent woodlands were examined in western Maryland. We determined structural classes from measurements of vegetative structure and coarse woody debris. Small mammals in nine clearcuts (three each of three different stages) and three mature areas were live-trapped for twelve days per month in the fall, 1995, totaling 2,016 trap-nights. Preliminary analyses indicated no differences in sex ratios and weights of *Peromyscus* spp. among structural

classes. Differences in age distributions of *Peromyscus leucopus*, were marginally nonsignificant ($P < 0.10$) across treatments. Differences in proportional makeup of species were significant ($P < 0.05$) across structural classes. *Clethrionomys gapperi* was significantly ($P < 0.05$) correlated with percent herbaceous ground cover. *Blarina brevicauda* was marginally nonsignificantly ($P < 0.10$) correlated with depth of leaf litter. Greater herbaceous ground cover and leaf-litter depth contributed to higher proportions of *Clethrionomys gapperi* and *Blarina brevicauda* in clearcuts 5 to 7 years of age. Subsequent analyses will examine seasonal responses to additional features of clearcuts and adjacent forest.

- 112 DATEO, DOROTHY M.¹, FRANCIS L. PRECHT², AND RONALD E. BARRY¹. ¹Dept. Biology, Frostburg State University, Frostburg, MD 21532 and ²Dept. Geography, Frostburg State University, Frostburg, MD 21532 - Influence of habitat selection by black bears *Ursus americanus* on crop depredation in western Maryland.

We examined large-scale characteristics of potential black bear habitat to address damage to corn fields in Garrett County, Maryland. We constructed a habitat model for black bears in a Geographical Information System environment based on land use/ land cover, and stream and road density, and ranked the attractiveness of corn fields located in potential bear habitat for depredation by bears. Location, size, and elevation of damaged corn fields, their proximity to roads and streams, and adjacent habitat were determined. The model classified habitat for black bears in Garrett County as primary, secondary, or tertiary (unsuitable), based on habitat preferences of five female bears. Corn fields in primary and secondary habitat were analyzed for their attractiveness for depredation. Corn fields that were damaged had adjacent habitat that provided concealment cover and easy access for bears to ORV and hiking trails ($n = 60$, $p < 0.05$). The model has important management implications because it identified areas in Garrett County that should be maintained (primary habitat) or enhanced (secondary habitat) for black bears. Moreover, it indicated which corn fields are likely to attract black bears. Wildlife biologists could increase their efforts of educating potentially affected land owners in these areas on how to coexist with black bears.

- 113 MARSH, BRIAN AND DAVID MORTON Frostburg State University - Noninvasive examination of fat deposition strategies in temperate cave dwelling bats.

Bats must radically alter their energy budget to survive through winter hibernation. Programmed fat deposition in late summer and autumn provides energy through the hibernation period. Restrictive energetic, environmental, and perhaps other factors limit the time of fat deposition to relatively narrow windows. The hypothesis tested is interspecific and intraspecific variation occurs in the opening, closing and width of this window. Bats were trapped at cave entrances in western Maryland and southwestern Pennsylvania from July to November 1995 and 1996. Juvenile or adult age class, sex, forearm length, weight, fecal pellet counts, and time of capture were recorded for three thousand captures. All observed species displayed a distinct prehibernal increase in weight. The data is currently being analyzed for significant variation in the timing and rate of fat deposition. Monitoring bat populations at cave entrances also provides an understanding of the activity patterns at night roosts during the prehibernal period. Correlations between capture success and environmental variables—temperature, weather, sunset, and moonlight—are also described.

- 114 BARNWELL, MICHAEL K., GARY DURRANT, KENNETH PILGREEN, AND GEORGE CLINE. Dept. of Biology, Jacksonville State University - A comparison of rete mirabilia in the maxilla and dentary bones of bottlenose dolphins, *Tursiops truncatus*, with rete mirabilia in the flukes.

Marine mammals, like *Tursiops truncatus*, are adapted to an aquatic environment which has a high specific heat. This causes a drastic loss of heat from the animal to the water unless physiological mechanisms, like rete mirabilia, are in place to prevent such a loss of heat. Rete mirabilia allow the superficial tissues of marine mammals to be isothermic with their environment, which prevents loss of heat. Rete mirabilia are known to exist in various organ systems in marine mammals, such as flukes, fins, testis, ovaries, and the brain. Rete mirabilia have recently been documented in the maxilla and dentary bones of bottlenose dolphins. By using Magnetic Resonance Imaging (MRI), three-dimensional reconstructions, histological methods, and morphometric software, the differences in heat exchange capabilities and arrangement of rete system can be compared. This research was supported by a research grant from Alabama Environmental Council.

- 115 DURRANT, GARY E., MICHAEL BARNWELL, AND GEORGE R. CLINE. Department of Biology, Jacksonville State University, Jacksonville, AL 36265 - Using NOAA's CCOAST satellite imagery system in Biological Research and Education.

The National Oceanic and Atmospheric Administration (NOAA), in cooperation with the National Aeronautics and Space Administration (NASA), is distributing a DOS-based image analysis system for mapping out sea surface temperatures (SSTs) from satellite imagery. The system software, along with the SST satellite imagery, is available at no cost to educational users and institutions, both at the university level and at the K-12 level. The CCOAST software will run on any 386, 486, or Pentium PC that uses Microsoft DOS/Windows, or IBM OS/2 as an operating system. The monitor must have a minimum of SVGA graphics, and be able to show 256 colors. The RAM available to the DOS operating system is a critical requirement. You cannot exit Windows to DOS and have the system work correctly. Instead, the start-up, or booting process, must be set to offer a choice to the user between booting to DOS, or booting to Windows. CCOAST will only work on a Windows PC if the computer boots directly to DOS. The SST imagery (both same-day and archived) is available for every coastline of the 50 United States, including the Great Lakes, from NOAA labs scattered around the country. You can receive SST imagery from the Gulf of Mexico over the Internet, or by telephone modem, or by 3.5" floppy disks which can be mailed to you. Other data centers have different procedures for receiving SST imagery. We are currently using SST data to measure the annual cycle of sea temperatures that bottlenose dolphins are exposed to in the region of Mobile Bay, Alabama.

- 116 DOBSON, WILLIAM E., EILEEN STRAHL, AND LEON L. LUNDIE. Biology Dept., Appalachian State University, Boone, NC 28608-Isolation and screening of subcuticular bacteria from *Amphiopholis gracillima* for antimicrobial activity.

Amphiopholis gracillima brittlestars harbor bacteria in the subcuticular space. These bacteria may play a role in preventing pathogenic bacterial infestations during regeneration after autotomy by competitive exclusion or production of toxins. This study investigated the ability of the subcuticular bacteria to inhibit growth of pathogenic and opportunistic bacteria in culture. Bacteria from the subcuticular space were isolated using techniques to limit possible contamination from surface bacteria. Thirty-two monocultures of the resulting isolates, which represent at least 8 to 10 separate specific strains, were generated. The monocultures were tested for antibacterial activity against a range of pathogenic and opportunistic bacteria, including *Mycobacterium smegmatis*, *Micrococcus luteus*, *Escherichia coli*, *Pseudomonas fluorescens*, and others. All of the isolate bacteria were capable of arresting growth of the test bacteria. It is possible that the inhibitory toxins produced by the isolate bacteria could represent a novel class of antibacterial compounds for human medicine. Further, these results imply that the brittlestars have developed a unique defense against infection during wound healing.

- 117 REDDY, PALLA S, SHEA R. TUBERTY, AND MILTON FINGERMAN. Dept. of Ecology, Evolution, and Organismal Biology, Tulane University, New Orleans, LA 70118-Effects of cadmium and mercury on ovarian maturation in the red swamp crayfish, *Procambarus clarkii*: An *in vivo* and *in vitro* study

Mercury significantly inhibited *in vivo* ovarian maturation in the red swamp crayfish, *Procambarus clarkii*. While 5-hydroxytryptamine (5-HT) alone induced ovarian maturation *in vivo*, cadmium or mercury inhibited this 5-HT induced maturation. Ovarian explants exposed to mercury and either brain or muscle showed significant inhibition of ¹⁴C-leucine incorporation into ovarian proteins compared to the corresponding groups incubated in saline in the absence of mercury. The brain, which contains a gonad-stimulating hormone (GSH), induced significantly more incorporation of this amino acid than occurred in the control ovaries incubated with muscle. The observed reduction in the *in vivo* stimulatory effect of 5-HT in the crayfish also given cadmium or mercury could have been due to these methods preventing the ovaries from responding to released GSH and inhibition of GSH release.

- 118 PERRINE, GAIL L. AND DONALD C. TARTER. Department of Biological Sciences, Marshall University, Huntington, WV 25755 - Low pH tolerance of larval *Caenis amica* Hagen (Ephemeroptera: Caenidae) from a mitigated wetland in the Green Bottom Wildlife Area, West Virginia.

Several species in the genus *Caenis* are tolerant of pollution. The primary objective of this study was to determine the low pH tolerance of larval *Caenis amica*. The Green Bottom Wildlife Management Area is located along the Ohio River approximately 26 km northeast of Huntington, West Virginia. One-hundred larvae (2.50-4.45 mm, $\bar{x}$ =3.53 mm) of *Caenis amica* were collected with a long-handled dredge from a nearby

mitigated wetland. They were found in the silt near rooted vegetation. Under static bioassay conditions, larvae were experimentally tested to determine their tolerance to low pH. After a 24-hour acclimation period, they were exposed to five pH values (1.5, 3.0, 4.5, 6.0, 7.5/control) in a controlled environmental chamber at 10 C. The 96-hour TLM (mean tolerance limit) test was employed as a measure of acute toxicity to low pH. Linear regression analysis was used to determine the pH value at which 50% of the larvae survived after 96 hours. The TLM pH value was 5.2. Results will be compared with other laboratory pH tolerance studies of mayflies and other aquatic insects.

- 119 SMITH, BRADLEY E. AND JAY A. YODER. Dept. of Biology, Illinois College, Jacksonville, IL 62650 - Transforming into a 'superorganism' by clustering promotes water conservation in certain ants, beetles, cockroaches, ticks and mites.

We report a 'group effect' with regard to water balance in certain insects, ticks and mites. Maintenance of adequate levels of body water (water balance) is a problem faced by all arthropods. Water balance is a function of water gain and water loss. The large surface area to volume ratio characteristic of most arthropods is not the only factor that contributes to rapid water loss rates; high temperature and type of cuticular surface wax are also important components. Many arthropods form clusters as an adaptive behavior to help reduce water loss. Though common in eusocial Hymenoptera (ants and termites), until now it was not known that the fire ant, *Solenopsis invicta*; tropical fungus beetle, *Stenotarsus rotundus*; convergent lady beetle, *Hippodamia convergens*; Madagascar hissing-cockroach, *Gromphadorhina portentosa*; American dog tick, *Dermacentor variabilis*; house dust mite, *Dermatophagoides farinae*; and hissing-cockroach mite, *Gromphadorhina schaeferi* could regulate water loss in this way. In all of these cases, individuals in a group retain water more effectively (they have lower water loss rates) than isolated individuals. Certainly, defense and access to mates are major benefits of aggregation, and it is now clear that aggregation plays an additional role in water conservation.

- 120 FISHER, GINGER R. and RONALD V. DIMOCK, JR. Wake Forest University - The nutritional biology of *Unionicola formosa*.

This study has focused on the mode of feeding and nutrient acquisition of *Unionicola formosa*, a symbiotic water mite that spends its adult life in the mantle cavity of the freshwater mussel *Pyganodon cataracta*. Limited information available in the literature concerning nutrition in this genus suggests that the mites pierce the gill of their host mussel and ingest tissue or hemolymph. In the present study a number of methods were used to characterize the feeding biology of *U. formosa*. To determine if the mites were feeding on the mucus strand that the mussel produces during its own feeding, mussels with resident mites were exposed to a suspension of 2 micron fluorescently labeled beads. No evidence was found to indicate that *U. formosa* ingested the beads. Immunological assays with antibodies against mussel gill tissue, mucus and hemolymph were used to determine whether or not the mites were ingesting any host tissue. Preliminary results revealed a high molecular weight component that is shared in both the mussel gill tissue and the mites, consistent with a mucopolysaccharide. Immunological assays and histochemical staining for mucins are continuing to confirm or refute this evidence. While it is presumable that the mites are feeding on the mucus produced by the gill of their host mussel, their potential to acquire dissolved organic material from the mantle cavity is also being investigated.

- 121 WATSON, BRIAN T. AND RICHARD J. NEVES. Virginia Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0321 - Life history characteristics of two federally endangered freshwater mussels (family Unionidae).

Population assessments and fish host identifications were completed in 1996 for two federally endangered freshwater mussel species, tan riffleshell (*Epioblasma florentina walkeri*) and purple bean (*Villosa perpurpurea*), in the Clinch River watershed, Virginia. Both species exhibited high degrees of host specificity in laboratory tests, with results similar to those of previously examined congeneric mussel species. Host fish for *E. walkeri* were limited to the banded and/or mottled sculpin (*Cottus caroliniae* and/or *bairdi*) and several percids; greenside darter (*Etheostoma blennioides*), redline darter (*E. rufilineatum*), fantail darter (*E. flabellare*), and snubnose darter (*E. simotermum*). Fish hosts identified for *V. perpurpurea* were also the banded and/or mottled sculpin and two percids; the greenside darter and redline darter. The tan riffleshell population in Indian Creek, Clinch River system, is the largest and perhaps only reproducing population of this species. Size class structure of the population ranged from 19.9 mm to 53.3 mm (males) and 26.2 mm to 49.4 mm (females), with approximately 27% of the population below the mean reproductive age of five years. The purple bean population is considerably less abundant with limited evidence of reproduction. Size class structure of the population ranged from 22.9 mm to 66.7 mm, with approximately 16% of the population less than the mean reproductive age of five years.

- 122 NEILS, DAVID E. AND RICHARD J. NEVES. Virginia Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0321 - Translocation of freshwater mussels (family Unionidae) into the Holston River.

Freshwater mussels were translocated to three sites on the Holston River (two in the North Fork; one in the main stem), Virginia and Tennessee where they had previously been extirpated. A total of 4,030 mussels of 8 species were translocated in fall 1995. Mussels were stocked either in study reaches (~1000-2000m²) or experimental quadrats (3m²) and monitored quarterly through fall 1996. Survival in study reaches and quadrats ranged from 49% - 100% and varied seasonally, among species, and site of translocation. Abundance estimates were similar at the two North Fork study reaches throughout the study. Estimated abundance at the main stem study reach dropped about 60% from fall 1995 to the spring of 1996 and remained constant thereafter. Recovery of mussels stocked in quadrats ranged from 60 - 87% in fall 1995 but dropped to between 15 - 40% in fall 1996. Monthly visual inspection of marsupial gills and drift sample collections showed no evidence of glochidia brooding or release by females. Further histological examination confirmed that little reproductive activity was present in translocated mussels. Low energy reserves as a result of translocation stress are suspected as the cause for limited reproduction.

- 123 HEACOCK, CHARLES H. University of Tennessee-A study of freshwater mussels (*Bivalvia Unionidae*) of Little River, Blount County, Tennessee.

A survey of freshwater mussels of Little River, Blount County, Tennessee, was conducted from January 1993 to October 1995. The study area included 20 sites and covered 42.9 river kilometers. Additional collections were made, in November 1993, below the original study area. A total of 8 native unionid taxa were collected. The most abundant were *Fusconaia barnesiana* (Lea, 1838) and *Villosa iris* (Lea, 1829). The collections of A. E. Ortmann (1914-1915), P. W. Parmalee (1973-1991), and L. B. Starnes and A. E. Bogan (1988) are presented for a comparison.

- 124 CASTANO, DIANA F. Dept. of Biology, Appalachian State University, Boone, NC 28607 - An examination of the subesophageal region and ventral trunk ganglia in *Echiniscus* sp.

The organization of the ventral portion of the nervous system of *Echiniscus* sp. was analyzed to obtain information useful for elucidating the phylogenetic position of tardigrades. Serial TEM sections through the subesophageal region and the first two ventral ganglia were analyzed. Preliminary results revealed that the subesophageal region does not contain ganglia similar to those found in arthropods. The only subesophageal elements of the nervous system are ganglia for sensory receptors that innervate the ventral mouth cone. Previous investigators have shown the ventral ganglia to contain three nerves. The first ventral ganglia differ from the others in the absence of one pair of nerves. These nerves normally innervate the dorsum and their absence together with the presence of a posterior connective linking the supraesophageal ganglia to the ventral chain suggests that they may have been co-opted as auxiliary connectives. Although the first trunk ventral ganglia are significantly larger than the second trunk ganglia, they have a similar internal organization and the first are not thought to represent ganglia from more than one segment. In contrast to the organization of the cephalic nervous system in basal arthropods there is only one ventral commissure anterior to those of the of the ventral chain. These results indicate that the tardigrade brain is composed of fewer segments and hence exhibits less cephalization than the brain of arthropods.

- 125 TARTER, DONALD C.¹, DIANE R. NELSON², ERICA S. MIDKIFF¹, AND ERIC S. WILHELM¹. ¹Department of Biological Sciences, Marshall University, Huntington, WV 25755 and ² Department of Biological Sciences, East Tennessee State University, Johnson City, TN 37601- First records of tardigrades (Phylum: Tardigrada) from mosses in the New River Gorge, West Virginia.

Fifty-three miles of the New River and its gorge and 40 miles of its tributaries are preserved as the New River Gorge National River in southern West Virginia. The steep wall, meandering gorge is 700-1300 feet deep, averages one miles in width, and cuts through seven geological formations. Elevation in the New River Gorge ranges from 1300-3000 feet. Mosses were collected from several rocky ravines and talus slopes. The following species of tardigrades, including the state record *Diphyscon pinque* Marcus, were identified from the mosses: *D. higginsi* Binda, *D. n. sp.*, *Itaquascon* sp., *Macrobiotus hufelandi* Schultz, *M. occidentalis* Murray, *M. richtersi* Murray, *M. spectabilis* Thulin, *M. tonollu* Ramazotti, *Milnesium tardigradum* Doyere, *Minubiotus*

intermedius (Plate), and *Pseudechiniscus suillus* (Ehrenberg). Twenty-seven species of tardigrades have now been reported from West Virginia.

- 126 GAUGLER, MICHAEL S. AND DIANE R. NELSON. East Tennessee State University - Marine interstitial Tardigrada of Dauphin Island, Alabama.

During July-August 1994 and January-March 1995, 125 sand samples were collected from both moderate energy and low energy beaches on Dauphin Island, Alabama. Three methods, all involving freshwater shock, were used to process the samples, which were preserved in 10% buffered formalin with rose bengal added to stain specimens. Samples were rinsed in alcohol to remove formalin and searched under a dissecting microscope to find tardigrades. Specimens were mounted in Hoyer's medium on microscope slides for identification. From 2 samples, 13 specimens were collected, belonging to 3 species of the genus *Batillipes*: *B. mirus*, *B. friafi*, and *B. sp.* All 3 species were found in both positive samples, which were collected on low energy beaches, one site on the east end facing the Gulf of Mexico, and one site on the west end facing the Mississippi Sound. Additional samples were collected in August-September 1996 from 3 sites, and thousands of tardigrades were found. Further analysis of the samples will elucidate patterns of distribution, which are typically extremely patchy.

- 127 HAMILTON, ROBERT IV¹, JANET W. REID², AND RICHARD M. DUFFIELD¹. ¹Dept. of Biology, Howard University, Washington, DC 20059 and ²Dept. of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560-Identification of Copepoda (Crustacea) in the leaves of the purple pitcher plant, *Sarracenia purpurea* L. (Sarraceniaceae).

The purple pitcher plant, *Sarracenia purpurea* L., has been shown to contain a number of invertebrates that feed on various organisms and organic matter within the leaves. While many studies focused on the macroinvertebrate associates such as the mosquito, *Wyeomyia smithii* (Coquillett), and the chironomid, *Metrocneenus knabi* (Coquillett), few have investigated the microinvertebrates. Our samples of contents of *S. purpurea* leaves from four bogs in the eastern United States contain several species of copepods. The number of individual copepods and species in the four collection sites varies greatly. A total of fourteen species of copepods representing nine genera and two orders have been identified. Five species are newly associated with *Sarracenia purpurea*. This represents a significant extension of previous reports of copepods in pitcher plants and acidic wetlands. This research is supported in part by the USDA-Forest Service (Eastern Region). RHIV is supported in part by a fellowship from the National Science Foundation Graduate Traineeship in Plant Biology (GER 9354916).

- 128 SCHOLTENS, BRIAN G. AND JOSEPH REZNIK. Biology Dept., College of Charleston, Charleston, SC 29424 - Status of the Lake Huron Locust (*Trimerotropis huroniana*), a Michigan threatened species, in the northern Great Lakes.

Investigations during the summers of 1995-96 have enabled us to better determine the entire distribution of the Lake Huron Locust (*Trimerotropis huroniana*), and examine some of the factors affecting its distribution and occurrence on Great Lakes dune systems. Factors affecting the distribution include habitat and host plant requirements, historical influences, human disturbance, and interactions with potentially competing species. Conservation strategies for the Lake Huron Locust which are based on these requirements must also take into account the requirements of several other threatened or endangered organisms that occur on the dune systems. Human disturbance, in particular, has widely varying effects on the different species.

- 129 BALDWIN, ANDREW S. AND RICHARD N. HENSON. Appalachian State University-The re-evaluation of the small *Diplocentrus* species in Texas.

Diplocentrus sp. was recognized in 1986 as a new scorpion species and is just now in the process of being described. This species collected from the different life zones within its presently known range is variable in appearance and it is hypothesized that more than one undescribed species is perhaps being considered under this one name. Discriminate analysis of a series of morphometrical measurements, traditional in scorpion descriptions, was used on specimens across its proposed range and compared to those measurements of the described species *Diplocentrus diablo*. Preliminary data suggest that *D. diablo* is a valid species and that several characters may validate two distinct species under the genus *Diplocentrus*.

- 130 HERR, J. M., JR. University of South Carolina—Repetitive ontogeny in angiosperms and its unusual occurrence in the *bell-3* mutant of *Arabidopsis thaliana*.

Repetitive ontogeny, the driving force in the indeterminate growth of shoot and root axes of vascular plants, sometimes occurs where growth is determinate. This rare phenomenon occurs in plants of nature as shown, for example, by individual determinate floral axes in the capitate inflorescences of *Rudbeckia hirta* which, instead of producing flowers, form new capitate inflorescences. In the *bell-3* mutant of *Arabidopsis thaliana*, the outer integument develops as a variable number of columnar, axial structures. The ultimate fate of these integumentary axes is transformation to carpeloid structures. Floral appendages to include carpels are foliar in nature (Goethe, 1790), i.e., they are modified leaves on a determinate axis (receptacle). According to the *telome theory*, leaves originated through the fusion of stem axes, and the mechanism for the process is actually put into full effect in the transformation of the integumentary axes to carpels. Often in plant development, ontogeny is patterned after the events of phylogeny (*biogenetic law*), but seldom if ever does leaf or carpel initiation, growth, and development follow these phylogenetic events. Ovules evolved from a system of telomes ultimately placed either at the apex of the floral axis or at the terminus (margin) of the dichotomous system that produced the carpel. Mutation of the homeotic gene, *BELL1*, eliminates the suppression of genes that express the primitive axial form of the outer integument in the *bell-3* mutant. The integumentary axes ontogenetically repeat the phylogenetic pattern that effected the origin of leaves, and this transformation represents not only repetitive ontogeny but repetitive phylogeny as well.

- 131 DROZDA, NICHOLAS AND ZACK E. MURRELL. Department of Biology, Western Kentucky University, Bowling Green, KY 42101 -Variation and species boundaries in *Hexastylis heterophylla* (Ashe) Small.

Hexastylis heterophylla (Ashe) Small is a variable species with a range that extends from northern Alabama to West Virginia. The flowers of northern populations have been described as larger, with prominently flared calyces, often with the odor of sour milk, whereas, southern populations have been described with flowers that are smaller, not flared, and odorless. It has been suggested that the larger fragrant flowers are outcrossing and the smaller unscented flowers reproduce only by selfing. The present study reports preliminary data from morphological and molecular analyses of this variation. Specimens have been examined from A, GAM, GH, MO, NCU, TENN, US and USCH, as well as collections made throughout the range during Spring, 1996. Floral and vegetative characters were examined, including leaf blade length and width, lobe overlap at leaf base, and flower characters such as calyx length, diameter of calyx opening, calyx lobe length and width. The distribution of *H. heterophylla* is sympatric with *H. naniflora* in the south and *H. minor* in the north, and these three species are considered to be closely related. There is a possibility that the variation in *H. heterophylla* represents introgression with *H. naniflora* and *H. minor*. To test this hypothesis and to examine variability within the species, Randomly Amplified Polymorphic DNA (RAPDs) and DNA sequencing using the Internal Transcribed Spacer (ITS) region is underway. Preliminary results of both molecular and morphological methods indicate that *H. heterophylla* is highly variable, but appears distinct from both *H. naniflora* and *H. minor*.

- 132 MURRELL, ZACK E., PATRICK E. CARROLL, AND SCOTT A. MYERS. Department of Biology, Western Kentucky University, Bowling Green, KY 42101 -Examination of species boundaries in *Hexastylis contracta* Blomquist and *H. rhombiformis* Gaddy using the Internal Transcribed Spacer (ITS) region of nuclear rDNA.

Hexastylis contracta Blomquist and *H. rhombiformis* Gaddy are rare herbaceous perennial plants endemic to southeastern North America. *Hexastylis contracta* exhibits a disjunct distribution, being found on the Cumberland Plateau of Tennessee and Kentucky and also 300 km east in the Blue Ridge Mountains of North Carolina. The distribution of *H. rhombiformis* is generally sympatric with *H. contracta* in North Carolina, but with allopatric populations to the north and south in the southern Appalachian Mountains. Barringer's treatment of the genus for the Flora of North America combines the two species. This study reports an examination of the Internal Transcribed Spacer (ITS) region of nuclear ribosomal DNA comparing *H. contracta*, *H. rhombiformis*, and *H. arifolia* var. *ruthii*. Results show that *H. contracta* (sensu stricto) is generally monomorphic for the ITS region, with no variation between the two disjunct distributions, suggesting a fairly recent geographic separation of the species. *Hexastylis rhombiformis* exhibited variability in the ITS region, with two individuals similar to *H. contracta*, two individuals similar to *H. arifolia* var. *ruthii*, while four individuals possessed unique sequence patterns. These results corroborate the morphological analysis suggesting that some specimens identified as *H. rhombiformis* may be of hybrid origins, but the unique sequences suggest that this taxon has its own evolutionary fate and should be recognized as a segregate species.

- 133 UNWIN, MATTHEW and LINDA E. WATSON. Department of Botany, Miami University, Oxford, OH 45056 - The role of ecotypes in the speciation process: A molecular re-examination of the Clausen, Keck, and Heisey studies on *Achillea*.

The *Achillea* ecotypes of western North America form one of the most extensive series of ecological races known in plants, with alpine to maritime forms, which are well-differentiated in morphology and physiology. Clausen, Keck, and Heisey conducted the classic studies on these ecotypes by doing complex reciprocal transplant experiments, documenting the genetic component of this pattern of differentiation. Their results later formed the basis for subsequent models on plant speciation, involving divergence among ecological races that are adapted to different local environments. These models proposed that because ecotypes or races form an intermediate stage between populations and species, that they consequently play an important role in species formation. The primary evidence, which is circumstantial, is the fact that partial reproductive barriers can exist among races. However, despite the widespread acceptance of the importance of race formation in speciation processes, there have been no empirical studies examining this assertion. Therefore, we initiated a molecular study to test the hypothesis that racial divergence leads to speciation, by determining if an expected hierarchical or phylogeographic pattern exists among ecotypes. We are sequencing the internal transcribed spacers (ITS) and intergenic spacer regions (IGS) of nuclear ribosomal DNA. The resulting sequences are being analyzed with phylogenetic methods, to test for a hierarchical pattern among the ecotypes.

- 134 STRANGE, REX MEADE. Dept. Biological Sciences, University of Alabama, Tuscaloosa, AL 35487 - Mitochondrial DNA Variation in Johnny Darters (*Pisces: Percidae*) From Eastern Kentucky: Stream Capture and the Origin of the Upper Cumberland River Fish Fauna.

The upper Poor Fork of the Cumberland River has been interpreted as a hybrid zone between *Etheostoma nigrum* and the closely related *E. susanae*. I examined mitochondrial DNA (mtDNA) diversity among *E. nigrum* populations in the Kentucky River drainage, *E. susanae* populations in the Cumberland River drainage, and the population occurring in the putative hybrid zone of the Poor Fork. Fifteen restriction enzymes revealed the presence of 4 mtDNA haplotypes among 60 individual fish. Two haplotypes were unique to the Kentucky River (K1 and K2), and were separated by a single restriction site. In the Cumberland River, a distinctive haplotype (S1) was possessed by all individuals identified as *E. susanae*, and a second haplotype (CN1) in the upper Poor Fork by those individuals identified as *E. nigrum*. These latter fish from the upper Poor Fork of the Cumberland River were phenotypically and genetically more similar to *E. nigrum* populations in tributaries of the upper Kentucky River, and were probably introduced by stream capture. This implies that more than one event or mechanism was responsible for the isolation of fishes in the upper Cumberland River.

- 135 BONE, SAMANTHA J. AND ROGER SAUTERER. Jacksonville State University - An electrophoretic study of two geographically isolated populations of *Elimia acutocarinata* (Lea 1841).

Two populations of *Elimia acutocarinata*, a fresh-water snail, from Cave Springs, Georgia, that have been geographically isolated from each other for over 75 years, were analyzed for genetic diversity. Previous studies have shown each population to have a distinct breeding pattern, one population reproducing twice during a breeding season whereas the other reproduces only once. The two populations do not interbreed. Electrophoretic and isozyme analyses were used to determine the degree of speciation that has occurred between the two populations.

- 136 MCELROY, TOM C. AND WALTER J. DIEHL. Dept. Biological Sciences, Mississippi State University, P.O. Drawer GY, Mississippi State, MS 39762 - Coarse-grained spatial environmental heterogeneity, allozyme heterozygosity, and growth in the earthworm *Eisenia fetida andrei*.

Biweekly growth rates (for 10 weeks) and genotypes of 7 polymorphic allozyme loci were measured in juvenile earthworms raised in all combinations of 3 soil moistures and 4 temperatures (N=1062). The moisture X temperature environment had a significant effect on MLH ($P < 0.01$), heterozygote deficiency ($P < 0.05$), and growth ($P < 0.001$). There were no significant correlations ($P > 0.05$) between growth and multilocus heterozygosity (MLH) within any constant moisture X temperature treatment. Among pooled treatments (simulating coarse-grained, spatial heterogeneity), growth was correlated significantly with MLH ($P < 0.05$). Assuming that genotypes were assigned randomly to treatments, heterozygosity patterns were likely caused by environmentally induced, genotype-specific patterns of mortality. A significant relationship between MLH and growth was detected in pooled treatments because there was sufficient similarity between the patterns of environmental effects on

growth (independent of genotype) and environmental effects on heterozygosity. MLH-growth relationships may be revealed by sampling a population in a spatially heterogeneous environment. The different components of the environment may vary at any given time with different physiological effects. The mechanisms of heterosis may be locus-, environment- and /or species-specific. (Supported by NSF DEB-9221094 to WJD).

- 137 JHEE, EDWARD M. AND A. JOSEPH POLLARD. Department of Biology, Furman University, Greenville, SC 29613 - Feeding responses of *Pieris napi* (Lepidoptera) to genetic variation in zinc content of *Thlaspi caerulescens* (Brassicaceae).

Thlaspi caerulescens is a European plant that hyperaccumulates zinc in its leaf tissues, to concentrations commonly exceeding 2% (dry weight). The hypothesis that metal hyperaccumulation represents a defense against herbivory has been supported by studies comparing feeding on plants grown in high-metal substrates (soil or hydroponic solutions) versus plants grown in metal-free or low-metal substrates. However, the more relevant comparison in evolutionary terms would involve plants whose metal concentrations differ due to genetic rather than environmental causes. It is known that significant genetic variability exists, both between and within populations of *T. caerulescens*. For this study, plants were grown in a uniform hydroponic solution containing 10 mg/l Zn. Foliar Zn concentrations were measured using atomic absorption spectrometry, and plants of strongly contrasting Zn concentration were chosen for feeding trials. Larvae of the veined white butterfly, *Pieris napi oleracea* were presented with pairwise feeding choices between high-Zn and low-Zn leaves. Comparisons of feeding damage revealed no statistically significant differences when young larvae were used, but highly significant avoidance of high-Zn leaves by later-instar caterpillars. This indicates that hyperaccumulation could evolve as an adaptation to the selective pressures of herbivory. The results are also relevant to attempts to use hyperaccumulators in the remediation of metal-contaminated soil.

- 138 POLLARD, A. JOSEPH. Department of Biology, Furman University, Greenville, SC 29613 - Deterrence and toxicity of hyperaccumulated heavy metals to generalist and specialist herbivores.

A growing body of evidence suggests that the rare phenomenon of metal hyperaccumulation in plants may act as a defense against herbivores. We have examined the defensive role of hyperaccumulated metals in two contrasting plant-herbivore interactions. British *Thlaspi caerulescens* plants were grown hydroponically in control media (low Zn, no Ni or Cd) and in solutions which caused high foliar levels of Zn, Ni, or Cd. Leaves were presented to larvae of the large white butterfly, *Pieris brassicae*. This species is not known to feed on *Thlaspi* in the wild, but fed and developed normally on control leaves. Caterpillars showed strong avoidance of high-Zn leaves in choice tests, and very high mortality if given no choice. Ni was also highly toxic; deterrence was significant only at high Ni concentrations. Cd showed neither deterrence nor toxicity. We also studied a system in which plant-herbivore coevolution may have occurred, involving the flea beetle *Psylliodes instabilis* and the nickel hyperaccumulator *Alyssum fallacinum*, which are associated in their native habitats in Crete. Nickel hyperaccumulated by both *A. fallacinum* and *T. caerulescens* showed neither toxicity nor deterrent properties toward *P. instabilis*. The beetles did prefer control to high-Zn leaves of *T. caerulescens* in choice tests, but Zn had no demonstrable toxicity to these insects over the course of our experiments. These results suggest that both deterrence and toxicity of heavy metals in plants may differ depending on the degree of specialism of the herbivore in question.

- 139 SANDERS, ANNA K., SOFIA WAHAJ, DOUGLAS J. LEVEY AND MARTIN L. CIPOLLINI. Berry College and University of Florida - A test of the fruit laxative hypothesis in *Solanum americanum*. Do glycoalkaloids hasten seed passage in birds?

The presence of potentially toxic secondary metabolites in ripe fruits of *Solanum* (Solanaceae) species presents an evolutionary paradox. One hypothesis explaining this paradox is the Fruit Laxative Hypothesis, which states that secondary metabolites may act to enhance seed passage rate which can reduce possible negative effects of gut passage on seed viability. We approached this hypothesis by focusing on the glycoalkaloids solasonine and solamargine of *Solanum* fruits. We isolated these alkaloids and prepared synthetic fruits with varying alkaloid concentration. We also synthesized fruits using a crude extract of *Solanum americanum* (Black Nightshade) fruit. We fed artificial fruits to Cedar Waxwings (*Bombycilla cedrorum*) and determined seed passage rate. While the glycoalkaloids had no apparent effect on gut retention time, the whole fruit extract was found to significantly decrease seed retention time. These data suggest that while glycoalkaloids do not enhance seed passage rate, there may be another secondary metabolite responsible for a decrease in retention time. Nevertheless, results of tests looking for a relationship between gut retention time and seed viability were inconclusive.

- 140 SCOTT, JON B. AND JAMES E. JOY. Marshall University - Parasites of the Snapping Turtle, *Chelydra serpentina*, from western West Virginia.

Twenty-one snapping turtles, *Chelydra serpentina* (Linnaeus), were collected in Cabell and Mason Counties, West Virginia, in August through September 1991, and May through June 1996. Parasites found were the blood protozoan, *Haemogregarina* sp.; the digenetic trematodes *Telorchis corti* Stunkard, 1915, *Auridistomum chelydra* (Stafford, 1900) Stafford, 1905, *Heronimus chelydrae* MacCallum, 1902 and *Spiroorchis* sp.; the nematodes *Spiroxyx contortus* (Rudolphi, 1819) Schneider, 1866, *Falcaustra* sp. and *Dracunculus globocephalus* Mackin, 1927; and the acanthocephalan, *Neoechinorynchus* sp.

- 141 TUCKER, R. B. and J. E. JOY. Marshall University--Symbionts of *Plethodon punctatus* and *Plethodon wehrlei* from eastern West Virginia.

Two closely related salamander species, *Plethodon punctatus* and *P. wehrlei*, were collected in the eastern panhandle of West Virginia from May through August of 1995 and 1996, and examined for symbionts. The ciliated protozoan, *Cepedietta michiganensis*, was observed in 15 of 25 (60.0%) *P. punctatus*, and 3 of 13 (23.1%) *P. wehrlei* individuals. While tissue sections reveal ciliate densities of such magnitude that the host duodenum seems occluded, there was no gross distention of this section of the intestinal tract. Prevalences of the nematode *Batracholandros magnavulvaris* were 52.0% (13 of 25) and 30.7% (4 of 13) for *P. punctatus* and *P. wehrlei*, respectively. Mean intensity (as mean number of nematodes per infected salamander) was 3.4 and 4.0 for *P. punctatus* and *P. wehrlei*, respectively. Both *C. michiganensis* and *B. magnavulvaris* are found in a variety of salamander hosts, but this report represents the first collection of these symbionts for both *P. punctatus* and *P. wehrlei*.

- 142 EMERY, M. and J. E. JOY. Marshall University--Helminth parasites of the ravine salamander, *Plethodon richmondi*, in Wayne County, West Virginia.

Twenty ravine salamanders, *Plethodon richmondi* Netting and Mittleman, were collected from a wooded hillside overlooking Beech Fork Lake, Wayne Co., West Virginia in February and March of 1996. The nematode, *Angiostoma plethodontis* Chitwood, 1933, and digenetic trematode, *Brachycoelium* sp., were found in the small intestine of this host species. Prevalence of *A. plethodontis* was 55% (11/20) with a mean intensity of 1.8. Only five of the 20 (20%) salamanders were infected by *Brachycoelium*, with a mean intensity of 2.8. This is the first report of *A. plethodontis* from *P. richmondi*, and the first report of this nematode species from West Virginia.

- 143 CRANK, C. and J. JOY. Marshall University--Plagitura spp. (Trematoda: Digenea) in red-spotted newts from western West Virginia.

Two species of *Plagitura*, *P. salamandrae* and *P. parva*, have been identified from newts. Often, however, the two species are difficult to differentiate morphologically, especially when non-gravid forms are being examined. Seventy-nine newts from a total host sample of 124 (55 females and 69 males) collected throughout 1995 in Wayne County, West Virginia, were infected by members of the trematode genus *Plagitura*. Prevalence of *P. salamandrae* and *P. parva*, in cases of single infection, were 25.0% (31/124) and 14.5% (18/124), respectively. Five (4.0%) newts were infected by both species concurrently. An additional 25 newts were infected by immature forms of *Plagitura* which could not be identified to species. Prevalence of *Plagitura* spp. by sex of host was virtually identical at 63.6% (35/55) for females and 63.8% (44/69) for male newts.

- 144 SCHOTTHOEFER, ANNA and GERALD W. ESCH. Wake Forest University -Changes within a guild of trematodes and their effects on community structure in the pulmonate snail, *Physa gyrina*.

As part of a long-term study, the component community of larval trematodes within *Physa gyrina* was examined in Charlie's Pond, located in the Piedmont area of North Carolina. Approximately 140 snails were collected each month between April and November 1996 from each of three sites in the pond where sampling had been conducted in prior studies. A total of 4 trematode species was found in the snails, 3 which had been previously observed and one new species. However, *Halipegus eccentricus*, a hemiurid trematode that had consistently reached a summer prevalence of 50% in past studies, was not present. In addition to *H. eccentricus*, 2 other species which had been present in prior years were also locally extinct. With the exception of *Megalodiscus temperatus*, the prevalences of the remaining trematodes did not increase in the absence of these now extinct species, suggesting that competitive interaction among trematodes was not an important determinant of component community structure. Infracommunities in the current study were depauperate, with only 4.5% of infected snails having multi-species infections. Examination of the recruitment of trematodes in different areas of the pond revealed spatial and temporal heterogeneities in species prevalences. The long-term changes suggest that larval trematode communities are highly dynamic in terms of species composition, perhaps more so than previously suggested.

- 145 ZELMER, DEREK A.,¹ ERIC J. WETZEL,² and GERALD W. ESCH.¹ Wake Forest University¹, and Wabash College²--The role of habitat in the structuring of the *Halipegus occidualis* metapopulation of the green frog, *Rana clamitans*.

The transmission dynamics of *Halipegus occidualis* in its definitive host, *Rana clamitans*, have been examined over a five year period in Charlie's Pond (Stokes County, NC). The breeding season of the green frog, coincides with the period of worm recruitment, during which time male frogs are territorial, and females show strong site specificity. This allows inferences to be made regarding the suitability of a particular habitat for worm transmission based on frog infections. Four foci of infection were identified in the pond by plotting infrapopulation size against host location. These areas are all characterized by shallow water and proximity to reed beds, factors favorable for all 4 hosts in the life cycle. Over the five year period the proportion of frogs in these "hot spots" remained relatively constant, resulting in consistent year to year worm prevalences and intensities despite large fluctuations in frog population size. Removal of worms from heavily infected frogs in the fifth year showed that site selection can predispose a frog to heavy infection, and that worm density regulates infrapopulation size in heavily infected frogs.

- 146 BENZ, GEORGE W.,^{1,2} NICK CALOYIANIS,³ AND ADAM RAVETCH.⁴ Southeast Aquatic Research Institute,¹ Tennessee Aquarium,² Nick Caloyianis Productions, Inc.,³ and Ravetch Underwater Films⁴ -Copepods that attach to the eyes of Greenland sharks -are they lures that attract prey?

Recent observations of free-swimming Greenland sharks (*Somniosus microcephalus*) in Arctic waters have revealed some new information regarding this little-known shark and the parasitic copepod *Ommatokoita elongata*. *Ommatokoita elongata* commonly infects the Greenland shark. The adult female copepod tethers herself to the cornea of the shark by permanently attaching herself to an anchoring device known as the bulla. Damage to the eye seems significant with many infected corneas grossly appearing thickened and opaque. Some have hypothesized that this large and brightly colored parasite may act as a lure - enabling this lethargic shark to capture swift prey items such as seals and salmonid fishes. Stomach analysis of Greenland sharks we observed revealed them have recently eaten a wide variety of benthic prey items including brittle stars, several species of snails, cephalopods, and several species of small fish. Filmed observations of hooked and free-swimming Greenland sharks showed *O. elongata* in action, dangling from the eyes of their cryptically colored and slow moving hosts in a very eye catching fashion. Are these copepods lures? Watch the video and judge for yourself.

- 147 DEE, JENNIE L.,^{1,2,3} GEORGE W. BENZ,^{2,3} RYAN OTTING,⁴ and GREG SKOMAL,⁵ Southern Adventist University,¹ Southeast Aquatic Research Institute,² Tennessee Aquarium,³ University of Georgia at Athens,⁴ Massachusetts Division of Marine Fisheries⁵—Resource partitioning of the smooth dogfish by two species of parasitic copepods.

Spatial distributions of two species of parasitic copepods, were studied on 39 smooth dogfish (*Mustelus cams*) captured off Massachusetts. Total copepods per shark ranged from 0-47, with *Pandarus sinuatus* (range=0-47) typically outnumbering *Alebobion glaber* (range=0-8). Most *A. glaber* (75% males, 77% females) attached anterior to the first dorsal fin. Most *P. sinuatus* (65% males, 78% females) were collected from the second dorsal fin, with most of these (78% males, 81% females) attached at the fin's tip. Placoid scales taken from various locations indicated that 97% of *A. glaber* attached where scales exhibited fluted crowns, whereas 94% of *P. sinuatus* attached where scale crowns were smooth. While the primary attachment appendages of *Alebobion* and *Pandarus* species are morphologically and functionally different, we found no indication that scale differences functionally restrict distributions of these copepods. Furthermore, scales like those found underneath each species were also found elsewhere, where copepods were never collected.

- 148 BULLARD, STEPHEN A.,^{1,2} JEFFREY S. BRASWELL,^{1,3} and GEORGE W. BENZ.^{1,4} Southeast Aquatic Research Institute,¹ University of South Carolina,² E.I Du Pont de Nemours and Co.,³ and Tennessee Aquarium⁴—First report of oncomiracidia of genus *Dermophthirus*.

Examination of skin patches taken from the external body surface of blacktip sharks (*Carcharhinus limbatus*) captured in the Gulf of Mexico during the summer of 1995 revealed tiny (approximately 80 µm) monogene larvae. Because these larvae resided among a group of *Dermophthirus penneri* (Microbothriidae) adults and because the blacktip shark is not known to host any other monogene species at the body locations where these larvae were attached, we assumed them to be *D. penneri*. These larvae are quite different from the only other known microbothriid larvae of *Leptocotyle minor* in that they possess pigmented eyespots and well-developed hooks associated with the haptor. Some larvae were attached directly to the hard placoid scales of their host and some were nestled between placoid scales well below the water/body surface interface.

- 149 SOUCEK, DAVID J. and GAYLE P. NOBLET. Clemson University
Effects of copper contamination on recruitment of *Posthodiplostomum minimum* (Trematoda) by bluegill sunfish (*Lepomis macrochirus*).

A laboratory study was conducted to investigate effects of copper contamination on recruitment of the endoparasitic *Posthodiplostomum minimum* (also known as white grub) by bluegill sunfish (*Lepomis macrochirus*). White grubs, reported as encysted metacercariae in a number of fish species, were obtained from the viscera of bluegills. The life-cycle of this strigeid trematode then was established in the laboratory using chicks as experimental definitive hosts and physid snails as first intermediate hosts. Upon completion of development in snails, juveniles emerged as free-swimming cercariae which served as a source of infection for bluegills. The 96-hr LC50 of copper for bluegills was determined to be 0.892 ppm under laboratory conditions. In snail hosts (*Physa gyrina*) exposed to 2.5, 5 and 10% of the LC50 for bluegills, 93, 60 and 13% survival was observed, respectively. In experimental trials, uninfected fish were exposed to 2.5 and 5% of the bluegill LC50 for copper for two weeks prior to exposure to cercariae. Percent mortality and parasite intensity were determined for fish in each concentration and compared to that of control fish not exposed to copper. Other factors investigated include effects of copper on cercarial shedding by snail hosts and on cercarial viability.

- 150 FONT, WILLIAM F.¹ AND MARK C. RIGBY². ¹Dept. Biological Sciences, Southeastern Louisiana University, Hammond, LA 70803 and ²Dept. Biological Sciences, University of Alberta, Edmonton AB, Canada T6G 2E9 - Occurrence of *Spirocammallanus istiblenni* in tidepool and stream fishes of Hawai'i.

We redescribed *Spirocammallanus istiblenni* Noble, 1966 (Nematoda: Camallanidae) from specimens that we collected from the type host, the zebra blenny, *Istiblenni zebra*, that inhabited tidepools on the island of O'ahu, the type locality, and from specimens that we collected from the marbled blenny, *Entomacrodus marmoratus*, on the island of Hawai'i. Most species in the genus *Spirocammallanus* are parasites of marine fishes and *S. istiblenni* has been previously reported from several species of ocean dwelling fishes in Okinawa. One of us (MCR) found 4 species of marine fishes in Mo'orea, French Polynesia infected with *S. istiblenni*. In Hawai'i, with limited study of 10 species of marine fishes, we found infections in only the blackspot sergeant, *Abudefduf sordidus*, and Hawaiian flagtail, *Kuhlia sandvicensis*. Extensive surveys of freshwater fishes determined that

this nematode was present in 2 of 26 streams where a sleeper, 'o'opu akupa, *Eleotris sandwicensis*, occupying the stream mouth was occasionally infected. Loko'aka Pond, a spring fed, brackish water pond located within 30 meters of the ocean in Hilo, Hawai'i harbored many sleepers infected with *S. istiblenni*. Juveniles of *Camallanus cotti* commonly infect *E. sandwicensis* in many Hawaiian streams, and in the Wailoa River we found concurrent infections of *S. istiblenni* and *C. cotti* in these sleepers.

- 151 MUSSELMAN, LYTTON J. AND KERRY D. HEAFNER. Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266. Monograph of Southeastern *Isoetes*.

Based on studies of cytology, spore size and ornamentation, and ecology we currently recognize the following species of *Isoetes* in the Southeast: *I. acadiensis*, $2n=22, 44$; *I. boomii* (including *I. georgiana*), $2n=66$; *I. butleri*, $2n=22$; *I. caroliniana*, $2n=22$; *I. engelmannii*, $2n=22, 44$; *I. flaccida*, $2n=22$; *I. lacustris*, $2n=110$; *I. louisianensis* (perhaps conspecific with *I. saccharata*), $2n=44$; *I. melanopoda* (incl. *I. virginica*), $2n=22$; *I. melanospora*, $2n=22$; *I. piedmontana*, $2n=22, 44$; *I. saccharata* (incl. *I. hyemalis*) $2n=44$; *I. tegetiformans*, $2n=22$; and an undetermined MS collection, $2n=22$, possibly *I. mexicana*. *Isoetes riparia* is a northern species once confused with *I. saccharata* and *I. acadiensis*. No extant southeastern populations are known. *Isoetes melanospora* and *I. tegetiformans* are narrow endemics of granite outcrops in GA; *I. piedmontana* is the common quillwort of granite outcrops; *I. butleri* and *I. melanopoda* occur on non-granitic rocks. *Isoetes lacustris* is a boreal submergent found at one site each in TN and VA. *Isoetes acadiensis*, previously known only from Eastern Canada and contiguous states, is restricted to freshwater tidal marshes in the Chesapeake Bay in VA.

- 152 MCHENRY, DIANA J. AND KERRY D. HEAFNER. Dept. Of Biological Sciences, Old Dominion University, Norfolk, VA 23529-0266 -Electrophoretic studies of some southeastern quillworts (*Isoetes* spp.).

Gel electrophoresis of enzymatic proteins was conducted to determine genetic relatedness between several southeastern quillwort species. Preliminary studies of cytology and megaspore ornamentation reveal similarities between two tetraploids ($2n=44$), *Isoetes hyemalis* and *I. saccharata*. Both were previously included under *I. riparia*. If they are genetically identical, the name *I. saccharata* should be used. *Isoetes georgiana* and *I. boomii* were described simultaneously in 1992. Recent morphological studies have provided evidence that these fertile hexaploids ($2n=66$) may be conspecific. If these two putative species are genetically identical, the name *I. boomii* should be used.

- 153 RUSSELL, CAMERON L. AND REBECCA D. BRAY. Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266. A comparative study of *Isoetes boomii* and *Isoetes georgiana*.

Isoetes boomii (known only from the type locality) and *I. georgiana* (from seven counties) are hexaploid endemics of south Georgia distinguished on the basis of velum coverage and leaf color. Per cent velum coverage, megaspore diameter, megaspore ornamentation, chromosome number, presence or absence of peripheral strands, and ecology were examined. There is no significant difference in velum coverage between the two species. Megaspores of both species are similar in ornamentation and diameter. The chromosome number was consistently $2n=66$ from seven populations of *I. georgiana* and the single population of *I. boomii*. The presence and patterning of peripheral strands varied both within and among populations. These quillworts occupy similar habitats. Based on our data, these represent one species. Because both names were published simultaneously, the name *I. boomii* should be used to avoid confusion with *I. engelmannii* var. *georgiana*.

- 154 BARR, AARON D. AND LYTTON J. MUSSELMAN. Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266. New Hybrids in the Genus *Isoetes* (Quillworts) in the Southeastern United States.

Field studies indicate the presence of two new hybrids in the genus *Isoetes*. The hybrid between *I. piedmontana* ($2n=22$) and *I. tegetiformans* is found only on one granite outcrop in Georgia and has a chromosome number of

2n=22. This is the first hybrid reported in the Southeast that does not involve *I. engelmannii* as a parent. A putative hybrid between *I. engelmannii* (2n=22) and *I. flaccida* (2n=22) from Florida has a chromosome number of 2n=22. Hybrids are determined by the presence of malformed and aborted megaspores and also chromosome numbers. Previously reported hybrids include: *I. *altonharvillii* (*I. caroliniana* x *I. engelmannii*); *I. *carlittaylorii* (*I. acadiensis* x *I. engelmannii*); *I. *fairbrothersii* (*I. lacustris* x *I. engelmannii*); and *I. *bruntonii* [*I. hyemalis*(=*I. saccharata*) x *I. engelmannii*]. This brings to a total of six the number of hybrids reported in the Southeast.

- 155 BRAY, REBECCA D. AND LYTTON J. MUSSELMAN. Old Dominion University. Autopolyploidy in Quillworts of the Southeastern United States.

Autopolyploidy, in addition to allopolyploidy, may be a factor in the evolution of quillworts. Of the 15 species of quillworts in the southeastern United States, three species are known at two ploidy levels. *Isoetes engelmannii*, a common and widely distributed diploid of eastern North America, has a single tetraploid cytotype population in northwest Florida. *Isoetes piedmontana*, a quillwort common to granite outcrops of the southeast, exists as a tetraploid throughout its range from Alabama and Georgia north to Virginia. A few populations of *Isoetes piedmontana* in Alabama and Georgia are diploids. *Isoetes acadiensis* is an infrequent quillwort of tidal rivers of the Chesapeake Bay drainage system; it occurs more commonly in the North Atlantic maritime provinces. It is tetraploid throughout its range except for two diploid populations in the Chickahominy and Pamunkey Rivers of Virginia. In addition to studying the cytology and morphology, an attempt was made to analyze the significance of the patterns of different ploidy levels in each of these species.

- 156 BURKE, IAN C. Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529-0266 -Occurrence, density, and topography of stomata in Virginia quillworts (*Isoetes*).

Stomata of *I. acadiensis*, *I. caroliniana*, *I. engelmannii*, *I. lacustris*, *I. melanopoda*, *I. piedmontana*, and *I. saccharata* were analyzed for occurrence, density, and topography. Stomatal density appears to decrease as the ploidy level increases. Stomatal density decreases from its maximum at the leaf apex to zero immediately above the ligule. Stomata are present in rows corresponding to each of the four air chambers of the leaf. They occur on submergent, emergent, and partially emergent leaves in all species examined except *I. lacustris*.

- 157 CAPLEN, CYNTHIA A. AND CHARLES R. WERTH. Department of Biological Sciences, Texas Tech University - Isozymic comparison of some diploid *Isoetes* species of eastern North America.

The genus *Isoetes* is beset with taxonomic uncertainties due to the limited number of morphological characters useful for species delimitation. Species identification tends to rely on megaspore ornamentation pattern, which has proven reliable for recognition of diploid species. However, morphological features, including megaspores, have been less successful in addressing the delimitation and ancestry of the confusing array of polyploid taxa occurring in this genus. As an initial step in a study of relationships in the *I. riparia* s.l. tetraploid complex of eastern North America, isozyme data were acquired (10 enzymes, 12 loci) to compare discrete genetic markers among possible ancestral diploids, including *I. valida* (= *I. caroliniana*), *I. engelmannii*, *I. flaccida*, *I. echinospora*, and *I. prototypus*. Levels of genetic variation within species ranged from very low in *I. echinospora* to relatively high in *I. flaccida*. Within-species genetic variability tended to be apportioned more among than within populations. Interspecific genetic identities varied from less than 0.2 between *I. engelmannii* and *I. prototypus* to a maximum of 0.58 between *I. flaccida* and *I. valida*. Thus, diploid species are well distinguished genetically by allozymes, corroborating their distinction based on morphology and potentially facilitating diagnosis of allopolyploid ancestry in the *I. riparia-hyemalis* complex.

- 158 McCLENEGHAN, S. COLEMAN. Department of Biology, Appalachian State University, Boone, NC 28608 -The *Pholiota alnicola* complex: A taxonomic revision.

Smith and Hesler (1968) defined the *Pholiota alnicola* complex as comprising five species, two with infraspecific taxa. Utilizing 69 collections and cultures of members from this complex from North America

and Europe, a study to resolve the systematics of this complex has been conducted. Methods used include: (1) phenetic analysis of morphological data from basidiomata; (2) examination of type specimens; (3) phenetic analysis of culture morphology; (4) elucidation of mating systems; (5) determination of interbreeding compatibility; and (6) comparison of enzyme electrophoretic profiles. Results from these data sets show this to be a highly variable complex that does not sort according to Smith & Hesler's morphotaxonomic concepts.

- 159 MCGUIRE, ROBERT F. AND DAVINDERJIT K. BAGGA. University of Montevallo - A rethinking of the number of algal divisions

Algae, a diverse group of thallophytes with chlorophyll *a* and beta carotene, vary in size from unicellular to giant kelps. The organization of these groups has evolved from the single Division Thallophyta of Eichler in 1883 to as many as thirteen Divisions proposed by Round in 1977. The purpose of this study has been to review by numerical taxonomic procedures the traits that have traditionally been used to separate algal Divisions and to suggest from these calculated relationships whether some of the current Divisions should be kept or merged. The Divisions investigated were Cyanophyta, Prochlorophyta, Chlorophyta, Charophyta, Euglenophyta, Xanthophyta, Bacillariophyta, Chrysophyta, Phaeophyta, Pyrrophyta (Dinophyta), and Rhodophyta. This study omits some of the lesser known algal groups which have often been clustered with one or more of the above Divisions. The traits analyzed were cell type (eukaryotic or prokaryotic), pigments, thylakoid organization and stacking, stored food reserves, cell wall chemistry, type of flagella, and mode of flagellar insertion. Using standard numerical taxonomic techniques, simple matching coefficients were calculated and a dendrogram constructed. Clusters suggested as Divisions were: (1) Cyanophyta and Prochlorophyta; (2) Rhodophyta; (3) Xanthophyta, Bacillariophyta, Chrysophyta, and Pyrrophyta; (4) Euglenophyta; (5) Chlorophyta and Charophyta; and (6) Phaeophyta.

- 160 TURRILL, NICOLE AND EDWARD BUCKNER. The University of Tennessee - Restoring Southern Appalachian *Pinus rigida* communities with prescribed fire.

Charcoal fragments in bog and lake sediments and soils provide evidence of fire's natural influence on the prehistoric and historic landscape. In the southern Appalachian region, fire encouraged development of *Pinus rigida* (pitch pine) forests on the upper third of xeric slopes. Today, after nearly sixty years of effective fire prevention and suppression practices, pine regeneration niches are absent and *Pinus rigida* forests are being replaced by mixed *Quercus coccinea* (scarlet oak) and *Q. prinus* (chestnut oak) forests. Land managers must now decide the desired future condition of the southern Appalachian landscape. If fire continues to be excluded, developing hardwood forests will increase in extent and landscape heterogeneity will decrease. Conversely, reintroducing fire will restore pine forests. Research on the Warm Springs District of the George Washington and Jefferson National Forest (Hot Springs, VA) demonstrated that spring burning reduces hardwood canopy competition. Subsequent fall burning, just prior to seedfall, further opens the canopy, exposes mineral soil, and encourages pine regeneration. Such burning practices eventually increase pine seed sources and, thus, *Pinus rigida* dominance. Future research, following restoration of montane pine forests, should include watershed scale burning to increase southern Appalachian landscape heterogeneity.

- 161 IMM, DONALD W.¹ AND BARBARA P. MOYER². ¹Savannah River Forest Station, New Ellenton, SC 29807 and ²Savannah River Ecology Laboratory, Aiken SC 29803 - Changes in distribution and productivity patterns of *Sarracenia minor* following fire

Sarracenia minor, a carnivorous plant native to the southeastern Coastal Plain, is restricted to bogs, wet ditches, and savanna's. It is locally rare; only one population of *Sarracenia* exists on the Savannah River Site near Aiken, South Carolina. This population included 248 initial clusters. Dispersion, germination, growth, survival, and reproductive success of *Sarracenia* is potentially influenced by spatial, edaphic, and biotic factors of the past and present. Protection from fire has also altered community dynamics of *Sarracenia* habitats. Prior to burning, *Sarracenia* distribution and productivity was correlated with depth to water table, light availability, and shrub density. Less correlated parameters include soil acidity, soil nutrients, and litter deposition. Flowering and leaf stalk longevity is strongly correlated with light availability; whereas annual above-ground growth was better correlated with depth to water table. Following summer fire, 9 clusters were eliminated, 13 additional clusters were eliminated after 2 months. Seven new clusters were added

following fire. Post-fire productivity suggests a temporal auto-correlation with pre-burn biomass. Spring sampling efforts will focus on identification of new clusters.

- 162 SUCHECKI, SHARON R. and PHILIP A. ROBERTSON. Southern Illinois University at Carbondale--Response of herbaceous species to experimental restoration of a limestone glade, Monroe County, Illinois.

Forty-eight permanent 0.01 ha circular plots were established within two limestone glade openings and the surrounding dry upland forest at Fults Hill Prairie Nature Preserve in Monroe County, Illinois. Absolute cover of herbaceous species was measured in six 1 m² nested quadrats within each plot before and after implementation of restoration treatments: cut-and-burn, cut-and-herbicide, burn, and control. Treatments were designed to remove encroaching woody species, restore former glade structure, and increase herbaceous species abundance. First year results indicate an increase in total herbaceous cover in all treatments from 2.4% to 22.7%, except for the glade control plots, where total herbaceous cover decreased by 0.8%. Cover of individual herbaceous species tended to increase in treated plots, but response varied within the control plots. In general, the most substantial increases in herbaceous cover occurred in cut-and-burn and cut-and-herbicide plots. This research project was funded in part by the Illinois Department of Natural Resources, Natural Heritage Division from contributions to the Illinois Wildlife Preservation Fund.

- 163 BATTAGLIA, LORETTA L. and REBECCA R. SHARITZ. Savannah River Ecology Laboratory, Aiken, SC 29802 - Post-disturbance regeneration patterns in bottomland hardwood forests: the role of microsite heterogeneity.

Natural disturbances create microsite variability which may promote differential germination and seedling growth as well as non-random regeneration patterns over time. Small-scale variation in light and hydrologic conditions are common in bottomland hardwood forests which are frequently subjected to wind disturbances. Our objective was to compare demography of two bottomland hardwood canopy species, *Quercus michauxii* and *Liquidambar styraciflua*, across experimental microsite conditions over two years. Microsites were established in mesocosms in a split-plot design to mimic a range of light (0, 45, and 80% shade) and microtopographic (depth to water table = 50 cm and 2 cm) conditions. Seeds of each species were planted separately in each microsite type; germination, survival, and growth were monitored during the 1995 and 1996 growing seasons. Although *Quercus michauxii* had higher germination, survival, and growth than *Liquidambar styraciflua* in 1995, *Liquidambar styraciflua* survivors had greater growth by the end of the 1996 growing season. Both species had higher germination, survival, and growth on mound microsites than pit microsites in both years of the experiment, and microtopographic variation had a greater overall influence on regeneration patterns than did variation in light. Microsite heterogeneity in bottomland hardwood forests can influence spatial and temporal regeneration patterns.

- 164 GREENBERG, CATHRYN H. AND HENRY MCNAB. USDA Forest Service, Southern Research Station, Bent Creek Research and Demonstration Forest, Asheville, NC 28806 - Forest disturbance in hurricane-related downbursts in the southern Appalachian mountains of North Carolina.

We characterized five 0.2-1.1 ha gaps created by downbursts during Hurricane Opal in xeric oak forest at the Bent Creek Experimental Forest, Asheville, North Carolina. Direction of windthrow was nonrandom but differed among gaps suggesting that each was caused by an independent downburst. Windthrows reduced tree density by 19-39% and basal area (BA) by 30-53% within gaps. Most windthrows were uprooted (17-38% of all trees) versus broken below 1.8 m height (0-3%). *Quercus* spp. were the most vulnerable to windthrow, losing 27-47% of individuals and 41-57% of BA. *Quercus coccinea* lost ≥44% of trees and >55% of BA where it occurred. *Liriodendron tulipifera* lost >42% of individuals and >50% of BA in the site where it was most common. Only minor shifts in canopy species dominance was evident. Uprooting disturbed 1.9-4.3% of the ground area and displaced 129-587 m³ of root-soil-rock masses (rootmasses) per gap. Both were significantly correlated with tree dbh. We suggest that episodic disturbance events such as high-intensity wind have a substantial influence on forest structure, regeneration, species composition and microtopography of the southern Appalachian mountains.

- 165 TUBERVILLE, TRACEY D University of Georgia Effects of gopher tortoise (*Gopherus polyphemus*) burrows on herbaceous vegetation in the longleaf pine-wiregrass community.

Most studies on habitat associations of a particular species focus on how the species is affected by the vegetation community. Few studies have examined the reciprocal effect that some vertebrates may have on vegetation. In addition to consumption and seed dispersal, fossorial herbivores may alter their habitat through small-scale disturbance. Gopher tortoises, *Gopherus polyphemus*, are large turtles that build extensive underground burrows. During burrow construction and maintenance, tortoises create mounds of soil, called aprons, outside the burrow entrance. In 1996, I began a two-year study of the effects of these disturbances on herbaceous vegetation.

I randomly selected 15 active burrows, abandoned burrows, and undisturbed control locations. In addition, 15 randomly-placed mimic burrows were constructed. At each of the 60 stations, nine .5m x .5m vegetation plots were established: one on the apron and one each at 3m and 5m from the apron in each compass direction (i.e., 3mN, 5mN, etc.). Visual estimates of percent cover for each herbaceous species present were made in early and late summer. Percent cover and species diversity will be compared among the experimental groups.

- 166 ADAMS, ERIC D.¹, PAUL ROTHROCK², AND EDWIN SQUIERS². ¹Dept. of Plant Biology, Southern Illinois University at Carbondale, Carbondale, IL 62901 and ²Randall Environmental Center, Taylor University, Upland, IN 46989 -The development of a reconstructed prairie and possible flood effects (year two).

In the spring of 1993, Taylor University in cooperation with AVIS Industrial Corporation, began a large scale prairie reconstruction project on 10.1 hectares southeast of the University campus in Grant County, Indiana. Seven permanent transects were established to document the development and growth of the reconstructed prairie. The transects were positioned to include the diversity of topographic settings, including an area subjected to infrequent flooding. In August of 1994 plots were resampled using 15 randomly placed meter squared quadrats from each transect. Cover and density of each species was recorded. The change in volunteer and prairie species over the two seasons showed significant differences by transect ($p < 0.05$). Prairie species density was noticeably reduced in the saturated areas, while volunteer species showed an affinity toward the saturated soils.

- 167 GLICKAUF, STEVEN and JAMES FRALISH - Southern Illinois University - Herbaceous richness and cover in shelterwood cut forest stands at Land Between The Lakes, KY and TN

The effect of shelterwood cutting on the herbaceous understory of forest stands was studied at Land Between The Lakes. A total of 25 sampling units were located in 5 shelterwood cut oak-hickory stands. Each sampling unit was composed of 0.04 ha plot and four systematically placed nested 0.003 ha and 0.006 ha quadrats. Each sampling unit was required to contain at least one stump and an overstory canopy gap. On the 0.04 ha circular plot, species and diameter were recorded for trees > 9 cm while seedling (stems < 1.0 cm diameter) and sapling numbers were recorded by species on the 0.003 ha and 0.006 ha plots respectively. Percent cover was recorded for each herbaceous species within ten systematically located 1.4×1.4 m (2m^2) quadrats. Within each quadrat, litter was collected from a randomly located 0.25m^2 microplot. Soil and topographic data also were collected. Data from stands cut eight to twelve years previously indicates an increased herbaceous richness and cover when compared to the mature uncut stands on analogous sites studied by Close (1996). These increases appear related to an increased light level on the forest floor and a decreased litter volume both of which are associated with canopy gaps. However, where a dense stratum of saplings had developed after cutting particularly in stands receiving early cuts, herbaceous richness and cover is generally equal to or less than that of uncut stands. It appears that the characteristics of the herbaceous stratum vary widely with stand development and age. This research was supported by the Center for Field Biology, Austin Peay State University, Clarksville, TN and the Department of Forestry, Southern Illinois University, Carbondale.

- 168 BASINGER, MARK A. AND PHILIP A. ROBERTSON Dept. Plant Biology, Southern Illinois University at Carbondale - Response of the vascular flora in an old-growth forest in the Ozark Hills of southern Illinois to selective timber harvest.

The vascular flora of a 7.2 ha old-growth forest remnant in Union County, Illinois was surveyed in 1995 prior to a selective timber harvest and was resurveyed in 1996 to characterize changes in the floristic

composition. During 1995, 215 taxa were identified, of which 24 (11.2%) were non-native to the site. The dominant life forms were hemicryptophytes (76 taxa) and phanerophytes (63 taxa) and only 8 taxa (3.7%) possessed the C_4 photosynthetic pathway. In 1996, 354 taxa were identified, of which 67 (18.9%) were non-native. The dominant life forms were hemicryptophytes (129 taxa) and therophytes (114 taxa), and 24 taxa (6.8%) possessed the C_4 photosynthetic pathway. The number of annual species in the current flora is consistent with the early stages of succession and the site is characterized by plant species found in anthropogenically disturbed communities such as the agricultural fields that surround the forest. This study was partially funded by the U.S. Forest Service.

- 169 BASINGER, MARK A. AND PHILIP A. ROBERTSON. Dept. Plant Biology, Southern Illinois University at Carbondale - Response of herbaceous vegetation to selective timber harvest in an old-growth forest remnant in the Ozark Hills of southern Illinois

The effect of selective timber harvest on herbaceous vegetation is currently being investigated in a 7.2 ha forest in Union County, Illinois. Before timber harvest in the fall of 1995, herbaceous vegetation was sampled twice during the growing season in 116, 2 m² quadrats. In the late spring of 1995, mean species richness was 7.7/quadrat and percent cover was 34.6%/quadrat. A Kruskal-Wallis test indicated significant decrease ($p < 0.001$) in richness to 3.8/quadrat and cover to 20.7%/quadrat in the summer of 1995. This decrease was likely due to increased canopy cover from mesophytic forest species which have increased in the canopy and understory due to lack of disturbance. Following the timber harvest, richness (13.9/quadrat) and cover (55.9%/quadrat) in the spring of 1996 were significantly higher ($p < 0.0001$) than in the spring of 1995. During the summer of 1996, richness (13.1/quadrat) and cover (70.5%/quadrat) significantly increased ($p < 0.0001$) from the summer of 1995. Comparing 1996 samples, richness was not significantly different while cover was significantly higher in the summer sample ($p < 0.001$). The response of herbaceous species to timber harvesting was primarily due to increased solar radiation and an influx of plant species adapted to disturbed conditions. This study was partially funded by the U.S. Forest Service, Central Experiment Station, Columbia, Missouri.

- 170 ARNOLD, AMY E. University of Tennessee - Influence of microenvironment on growth and nutrient dynamics of three herbaceous species in a lower montane rain forest.

Three tropical herbaceous species, *Dieffenbachia seguine*, *Ichnanthus pallens*, and *Pilea inaequalis*, were investigated in a lower montane rain forest in Puerto Rico. Objectives were: (1) to characterize microenvironments of these species in terms of light and soil properties; (2) to examine relationships between estimators of plant performance and microenvironment; (3) to describe their ecological life cycles in terms of recruitment, mortality, growth, and clonal behavior, and (4) to determine their nutrient contents and rates of decomposition to better understand their role in nutrient dynamics and forest recovery following canopy disturbance. Results supported the following conclusions: (1) study species habitats were related to microenvironmental differences in soil moisture and nutrients, which varied by topographic position, but light environments were highly variable; (2) measures of plant performance in all three species were related to soil properties and/or light differences; (3) clonal reproduction was extensively used by these r-strategists, and (4) all three species concentrated nutrients above substrate levels and exhibited rapid decomposition rates. These three species may play an important role in nutrient dynamics, and thereby ecosystem resiliency, following canopy disturbance.

- 171 McCormick, Frank. The University of Tennessee - Sustainable Forestry in the Amazon.

Cutting of Amazonian forests destroys habitat which is indispensable to hundreds of thousands of species and hundreds of thousands of people. Deforestation cannot be stopped, and fortunately, need not be stopped if sustainable forestry is achievable. Precious Woods Ltd. offers a promising new model of sustainable forestry in Amazonas. This model includes ten procedures, which are consistent with principles of sustainability: (1) Local peoples participate and benefit, (2) Social, economic and environmental values are integrated in planning, (3) Within the 80,000 ha site, 25,000 ha are set aside as a biological reserve, (4) 50,000 ha are exploited at a rate of 2,000 ha annually. Accordingly, only 2.5% of the area is cut each year, leaving 97.5% in permanent or temporary reserve, (5) Inventory and GIS mapping of all trees > 5 cm dbh guides long term planning, (6) Extraction of over 40 species protects biodiversity and greatly reduces the area of extraction, (7) All trees are removed by cable and are transported via 10m wide logging trails, (8) Lianas are removed prior to tree cutting and direction of felling avoids trees of ecological or economic value, (9) Harvest is limited to trees > 50cm dbh and

40m³ (10%) of round wood per ha in order to conserve biodiversity and nutrients, (10) Silvicultural interventions are applied 3 times during the 25 year rotation. Environmental reforms can increase economic competitiveness and enhance environmental quality only if consumers support efforts to achieve sustainability and shun products derived from non-sustainable practices.

- 172 TAYLOR, DAVID D. USDA Forest Service, 1700 Bypass Road, Winchester, KY 40391 - Observations on populations of Appalachian monkey-face orchid, *Platanthera integrilabia* after two years of census.

Two years of complete census data, including flower counts and leaf age class, is available for six populations of *Platanthera integrilabia* in Kentucky. Based on these data, several observations are made. The populations are dynamic; individuals to clumps of 50+ plants present one year may not be present the next. Data suggest, except in one case, that individuals do not flower in successive years. Leaf age classes do not represent absolute plant age, but do represent an age class which spans two or more years. Highest flower per scape counts and fruit set percentages occurred in open sites. Higher flower per scape counts tend to occur in areas of 3500 or greater lux. Bud and scape failure appear related to both light intensity and moisture.

- 173 CROCK, CHRISTOPHER J.¹, LAWRENCE W. ZETTLER², AND DANIEL L. WYRICK.³ ¹Dept. of Biology, Furman University, Greenville, SC 29613, ²Dept. Biology, Illinois College, Jacksonville, IL 62650 and ³USDA Forest Service, CNF Supervisor's Office, Cleveland, TN 37320 - Factors contributing to the enormity of an orchid population in the southern Blue Ridge of Tennessee.

Isolated on a mountaintop in the Chilhowee range of Tennessee is a unique and enormous bog containing a noteworthy flora and fauna. It is suspected that an underlying bedrock of Nichols Shale surrounded by sandstone ridges permits the accumulation and slow drainage of water. Early this century (1907-1915) the bog area was subjected to human-related disturbances (logging, construction of drainage canals for growing crops). Today, the area accommodates the largest-known population of the rare Monkey-face Orchid [*Platanthera integrilabia* (Correll) Luer], suggesting that this species may have since benefitted from, or overcame the earlier disturbances. The availability of suitable mycorrhizal fungi (*Epulorhiza inquilina* Currah, Zettler, & McInnis) at the site undoubtedly played a key role in the establishment of *P. integrilabia* through seed germination. Wind-borne seeds of *P. integrilabia* from plants in the immediate vicinity or from distant populations in neighboring states represents the most like scenario behind *P. integrilabia*'s establishment. The long-term preservation of this unique bog and its life forms will require an understanding and management of the present-day threats (*i.e.*, herbivory by feral hogs, invasive plant species).

- 174 JOHNSON, MARGARET A. AND PHILIP A. ROBERTSON Southern Illinois University at Carbondale, Illinois. Environmental factors associated with growth and reproduction of *Matelea obliqua* in southern Illinois.

Matelea obliqua is a state threatened species in Illinois. Thirteen populations have been identified in a variety of habitats in southern Illinois. Six populations were studied to determine the relationship between selected environmental variables and leaf, flower and fruit production. Three populations growing in relatively open stands with high light penetration and a dense herbaceous layer contained from 45 to several hundred individuals with several plants producing flowers and fruit. The sites supporting these populations had an average of 76% ± 10% (std) canopy closure, 28% ± 23% (std) photosynthetic active radiation (PAR) at ground level, and 72% ± 18% (std) herbaceous layer cover per plot. The remaining populations had less than 25 individuals each, and an average of 93% ± 3% (std) canopy closure, 10% ± 9% (std) PAR, and 48% ± 30% (std) herbaceous layer cover. Few flowers and no fruit were produced in these populations. Canopy closure appears to be the most important factor associated with leaf ($r = 0.38$, $p \leq 0.0002$), flower ($r = 0.36$, $p \leq 0.0006$) and fruit ($r = 0.41$, $p \leq 0.0001$) production in the populations studied. This research is supported by the U.S. Forest Service.

- 175 HAMZÉ, SAMARA I. AND CLAUDIA L. JOLLS. Dept. of Biology, East Carolina University, Greenville, NC 27858 and University of Michigan Biological Station, Pellston, MI 49769 - The distribution of seedlings of the Great Lakes endemic *Cirsium pitcheri*.

The Great Lakes basin is a center of biodiversity having nearly 30% of its imperiled plant and animal taxa associated with the coastal shore ecosystem. The dune community harbors the federally threatened plant, Pitcher's thistle (*Cirsium pitcheri*) along Lakes Michigan, Huron and Superior shorelines. Metapopulation dynamics may control the geographic distribution and establishment of this threatened taxon, thus an understanding of dispersal ecology is imperative. During the summer of 1996, we evaluated the spatial relationships between adult plants and seedlings in a 4791 m² area using 61 plots of a 5 m radius. Our goal was to use distance and azimuth to seedlings from parents to determine whether a seedling shadow exists for Pitcher's thistle. The average distance between adult and seedlings was 245 cm and did not differ significantly among three sites along Lake Michigan. Although prevailing winds during the time of dispersal are largely from the northwest, the average seedling densities did not differ statistically among eight azimuth classes. This suggests seedlings are uniformly distributed around the adult plants. Seedling and adult plant densities were, however, sensitive to vegetation cover: areas with >60% bare sand supported the highest abundance of *Cirsium pitcheri* seedlings and adults. Because Pitcher's thistle is monocarpic, population persistence is dependent on establishment as seedling recruitment. Our data suggest that adults can be readily replaced by juveniles nearby, provided suitable sandy habitat is maintained by seasonal and stochastic disturbance. For metapopulation dynamics to persist, however, sandy habitat must be maintained locally as well as over larger geographic ranges.

- 176 TIFFANY S. LIN¹ AND JOLLS, CLAUDIA^{1,2}. ¹University of Michigan Biological Station, Pellston, MI 49769 and ²Dept. of Biology, East Carolina University, Greenville, NC 27858 - Apical meristem damage and reproductive output of *Cirsium pitcheri*, a rare endemic plant of the Great Lakes dunes.

Pitcher's thistle is a federally listed threatened monocarpic perennial which occurs vegetatively as a rosette of woolly, pinnatifid leaves. After 4-8 years, plants bolt and produce an inflorescence of flowering heads. This life history as well as threats from natural and anthropogenic disturbances make successful flowering and seed production critical for population persistence. Damage to the apical meristem from herbivory, scour or trampling can occur in up to 15% of individuals in the field, and produces multiple rosettes from a common tap root. Our objective was to determine whether this damage reduced reproductive output, or as shown for other taxa, plants compensated for the grazing and were unaffected. We estimated reproductive output of seeds using average number and size (total diameter) of flowering heads per plant to compare plants with and without apical meristem damage. Regression models predicted taproot as the best index of vegetative size to eliminate size differences between single- and multi-stemmed individuals. Probability of flowering is size-dependent in *Cirsium pitcheri*, as for other perennials. Total head number and total head diameter per plant were not significantly different between damaged and undamaged plants at four sites along Lakes Michigan and Superior. Total seed and percent seed set increased proportionally as head size increased, however, this relationship was the same for plants with and without damage to the apical meristem. Our data suggest that some damage from herbivory, scour or trampling may have no negative nor positive effect on the reproductive output of *Cirsium pitcheri*, provided survival to flowering and successful seedling establishment are unaffected.

- 177 DAVIS, J. ERIC JR. AND LAWRENCE S. BARDEN. University of North Carolina Charlotte - Restoration of a Piedmont prairie: potential species composition and demographics of the Federally endangered sunflower, *Helianthus schweinitzii* T & G (Asteraceae)

Once scattered throughout the region, the Piedmont prairie ecosystem is now relegated to disturbed sites such as roadsides and power line rights-of-way. Many plants with prairie affinities, such as the Federally endangered sunflower, *Helianthus schweinitzii*, persist in habitat fragments with uncertain futures. Species lists were compiled of plants currently found on the restoration site and of species potentially associated with Piedmont prairies. A 14-ha site was drum chopped and burned during July 1995, and half a million seeds of the sunflower and four prairie grasses were planted to test whether the presence of rocks affected either germination or survivorship. Rocks had no effect on the sunflower, and the effect on grasses varied by species. Since 1993, 1000 individual plants at two sites have been monitored annually to construct a demographic model. Plants responded to two prescribed burns with a 179% and an 825% increase in the production of flower heads. Preserving flowering adults is crucial for management. Managed populations have been increasing and stage model analysis predicts future growth as well. The weak point in the life cycle of the sunflower appears to be its inability to persist as its habitat becomes shaded during intervals between disturbances.

178 CUNNINGHAM, MAUREEN¹ AND MITCHELL B. CRUZAN². ^{1,2} Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, TN 37996; ¹Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831; and ²Department of Botany, University of Tennessee, Knoxville, 37996 -Demographic trends and host interactions of the rare hemiparasite, *Aureolaria patula* (Chap.) Pennell (Scrophulariaceae).

Aureolaria patula is a rare species that grows exclusively on slopes along waterways in east and central Tennessee and parts of adjoining states. It is a hemiparasite (a root parasite) reportedly of species in the white oak section of the genus *Quercus*. Little is known about the population biology of *A. patula*, about the factors contributing to its rarity, or about how interactions with its host species may be related to its habitat restriction and narrow geographic range. In this study I investigate demographic trends of four populations in east Tennessee and the need of *A. patula* and *A. virginica* (an ecologically similar species) for a host under various soil nutrient conditions in greenhouse containers. After two seasons of monitoring, preliminary results of demographic studies indicate that individuals may remain dormant over a growing season, recruitment of new individuals is occurring and that growth and flowering of *A. patula* are negatively affected by herbivores, including deer and insects. Results from the greenhouse experiment indicate that both *Aureolaria* species can survive without a host under low nutrient conditions, although growth is minimal. Growth under low nutrient conditions was increased by the presence of white oak for *A. virginica* but not for *A. patula*.

179 FAIREY, JOHN E., III AND DAVID W. BRADSHAW. Clemson University - Success of transplants from the basin of the Richard B. Russell Lake: A Final Report.

In 1992 plants of three rare South Carolina species, *Trilium cernuum* L. (= *T. rugellii* Rendle), *Panax quinquefolia* L. and *Aruncus dioicus* (Walt.) Fern., were transplanted onsite at Deal Creek, Abbeville Co. and offsite in the wild flower area at the S.C. Botanical Gardens at Clemson University. Reports on the initial success of these transplants were presented at these meetings in 1985 and 1988. The onsite transplants were largely unsuccessful and were abandoned after 1988. Droughts, differences in transplant habitat, animal predation and trampling could be factors in the failure of these transplants. The same species transplanted to the Clemson gardens generally have been more successful and initially exhibited sustained growth, no doubt due in part to a more suitable and secure habitat. However, over the past five years, these offsite transplants have shown a persistent decline. Although the average size of the plants has remained about the same, the number of individuals and the number flowering have exhibited a dramatic decline. The long-term success of these transplants is questionable. These observations over a 14 year period reflect the difficulties inherent in successfully transplanting native species from endangered habitats.

180 EDWARDS, LONNETTE G.^{1,2} AND JOAN L. WALKER². ¹ Clemson University, Clemson, SC, 29634 and ² Southern Research Station, USDA Forest Service, Clemson University, Clemson, SC, 29634 - Population structure of *Echinacea laevigata*, a Federally endangered species.

Declining populations and habitat loss were cited as reasons for listing *Echinacea laevigata*, smooth cone-flower, as Endangered. However, there are no published data on population dynamics that help managers understand causes for reported declines. The objectives of our ongoing study are to describe annual variation in population size structure, seedling establishment, and reproductive status of a single large population on the Sumter National Forest (Oconee County), SC. The habitat had been harvested and burned in 1992. In 1994, we permanently marked plants in five meter diameter plots. We recorded size, and status (vegetative, flowering, or seedling) of over 1000 rosettes, and report results from 3 seasons. The total numbers of plants increased from 85 to 167. While the number of rosettes remained nearly constant, the percentage of flowering rosettes decreased. The largest number of new seedlings was recorded in 1995; in all years seedlings represented less than 6% of all rosettes. We associate observed changes with progressive canopy closure since the initial fire. Experimental burning and monitoring will continue.

181 WALKER, JOAN L. AND DANA L. MADSEN. USDA FS, Southern Research Station, Clemson University, Clemson, SC 29634 -The breeding system of *Macbridea alba*, a federally threatened mint.

We performed experimental pollinations to test hypotheses about the breeding system of *Macbridea alba*. Treatments included open pollination (control), bagged (to exclude pollinators), anthers excised and bagged, self-pollination by hand, cross-pollination by hand, open pollination with added pollen load. We randomly assigned 10 plants to each treatment, and treated 10 flowers per plant. An analysis of variance indicated

significant treatment effects on mean seed set per flower. Open pollinated flowers produced significantly more seeds per flower (mean 3.06) than all other treatments. Self- and out-crossed flowers did not differ from each other (means 0.50 and 0.65 seeds/flower), but were significantly greater than either bagged treatment (both <0.06/flower). Among out-crossed flowers the identities of both donor and recipient significantly affected seed set. *Macbridea alba* is self-compatible and requires an insect vector for pollen transfer. Results are ambiguous with respect to an advantage of out-crossing over selfing; but among out-crossed flowers, at least some combinations of parental genotypes yield 100% seed set, a result not observed among self-pollinations. An abundance of pollen from closely related individuals may contribute to limited seed set in natural populations. Additional experiments to refine our understanding of the system will be conducted in natural populations in 1997.

- 182 HORN, CHARLES N.¹ AND LEE RINGER². ¹Biology Department, Newberry College and ²Governor's School of Science and Mathematics, Coker College. - An ecological study of the sedge *Carex prasina*, rare to the piedmont of South Carolina.

Drooping sedge, *Carex prasina*, is commonly found along stream edges in much of northeastern North America extending south into North Carolina and the mountains of South Carolina. In 1993, a population was discovered in Union County, South Carolina, well into the piedmont. This led to an investigation of the distribution and ecology of the species within the piedmont of South Carolina. A total of six populations were located, all along tributaries to the Tyger River. Plants typically grow at a stream edges under successional deciduous forests dominated by *Liquidambar styraciflua* (sweet gum), *Carpinus caroliniana* (ironwood), *Cornus florida* (flowering dogwood), *Ulmus alata* (winged elm), and *Acer rubrum* (red maple). Soils were typically saturated, of a sandy texture, and had a slightly acidic pH. Observation of population density and location along a stream clearly shows that plants are unable to withstand anthropogenic disturbances which result in openings and sedimentation.

- 183 RAE, JOHN G. Francis Marion University, Florence, SC - Predicting the population growth of an endangered cactus by transition matrices.

The endangered fragrant prickly-apple cactus (*Cereus eriophorus* var. *fragrans*) is restricted to a narrow pleistocene dune system bordering the Indian River in coastal southeastern Florida. From a demographic study spanning 1988-1993, a size-based Lefkovich transition matrix (A) was created for each of two populations. Over that five year period, the two populations were reduced in number by 41.8 % and 41.3 % respectively. The population size and size-distribution in 1996 [$n(t+3)$] were predicted by the equation: $n(t+3) = A^3 n(t)$ where $n(t)$ was the actual size distribution vector in 1993. These estimates were compared to the actual size distributions obtained in 1996. The populations continued to decrease from 1993-1996, by 39.3 % and 40.3 %, both in excess of predictions, indicating accelerating losses. In general, proportionately, the smallest size classes tended to grow and the largest size classes to decline, whereas the model's predictions were almost the opposite. The two largest size classes added together accounted for the greatest losses: 64.7 % and 54.8 % for populations one and two respectively. There is some evidence that much of this mortality was due to two separate causes: a) overgrowth and shading by trees, and b) complete dieback of nurse plants. Causes for continued recruitment failure are unknown.

- 184 STEPHENSON, STEVEN L.¹, GARY A. LAURSEN², AND RODNEY D. SEPPELT³. ¹Dept. of Biology, Fairmont State College, Fairmont, WV 26554, ²Dept. of Biology and Wildlife, University of Alaska, Fairbanks, AK 99775; and ³ Australian Antarctic Division, Channel Highway, Kingston, Tasmania 7050, Australia. - Subantarctic Macquarie Island.

Macquarie Island (54°30' S, 158°57' E) is an oceanic island 34 km long and 2.5 to 5.5 km wide located 1000 km south-east of Tasmania. The island, composed of oceanic crustal rocks lifted above sea level during the middle to late Pleistocene, lies close to but north of the Antarctic Convergence. The nearest land masses are the New Zealand shelf island groups of the Auckland Islands and Campbell Island, lying 640 and 700 km to the northeast, respectively. Macquarie Island is the southernmost island in the world with a fairly complete cover of vegetation, but the vascular flora is impoverished and consists of only 46 species. The general aspect of the vegetation is tundra-like, and the tallest plants are grass tussocks which sometimes reach a height of 1.5 m. Bryophytes, lichens, and low-growing vascular plants are the usual dominants in most situations, and there are no woody plants on the island. Five major types of plant communities are generally recognized: grassland (including both tall tussock grassland and short

grassland), herbfield, mire, fernbrake, and feldmark. The most diverse of these plant communities are the mixed herbfield communities that occur on raised coastal terraces.

- 185 ROLLINS, SARAH C., AND PETER S. WHITE. Curriculum in Ecology, University of North Carolina, Chapel Hill, NC 27599-3275. Calcareous glade communities in the Central Basin of Tennessee

The calcareous glade habitats in the Central Basin of Tennessee contain unique plant communities with rare and endemic species that are the focus of considerable conservation and management efforts. The purpose of this study was to examine the variation in the geographical distribution of glade species, the patterns in their community structures, and how these patterns correlate with environmental variables. In June of 1995 and from April-August 1996, a total of 19 glades distributed across 10 sites in Davidson, Wilson, Rutherford, Bedford, and Maury counties were sampled. Vegetation and ground cover were estimated at 5 spatial scales (100 cm²-100 m²) in 100 plots. Vegetation cover was estimated in 450 961 cm² subplots for three substrate categories: gravel, moss and soil. Soil samples, analyzed for texture and nutrient content, and topographic measurements were taken at the 100 m² and 961 cm² subplot scales, and nine soil depth measurements were made in the 961 cm² subplots. Preliminary analysis suggests that substrate type and soil depth may play an important role in community structure. Topographic variation influences the hydrological scheme of glades, controlling the deposition of soil and creating wet habitats dominated by sedges.

- 186 CLOSE, DAVID D. AND JAMES S. FRALISH. Southern Illinois University at Carbondale, Carbondale IL 62901 - Herbaceous dominance types and species response to an environmental gradient for undisturbed forest stands at Land Between the Lakes, KY and TN

Variation in herbaceous species composition was studied in undisturbed forest stands distributed along a soil moisture gradient from xeric to mesic conditions. In each stand, one of two previously established 0.06 ha circular macroplots was randomly selected for study. Within the macroplot, percent cover was recorded for each herbaceous species in ten, 1.41 m² systematically located quadrats. Within each quadrat, litter was collected from a randomly located 0.25 m² nested microplot. Average canopy cover was determined from four spherical densiometer readings. Additional tree data and environmental data were available from previous studies. DCCA in CANOCO was used to examine herbaceous response to environmental factors. Nine herbaceous dominance types were identified using Bray-Curtis similarity index values in an agglomerative clustering technique in COMPAH; an unweighted pairgroup method was employed. DCCA environmental axis 1 correlated strongly with aspect ($r^2=0.96$), slope position ($r^2=0.84$), and available water holding capacity ($r^2=0.70$). Stepwise discriminant analysis of fifteen variables indicated that herbaceous species response was related to slope position ($r^2=0.52$) and percent silt ($r^2=0.40$). When variables were categorized as operational (e.g., soil available water holding capacity, litter weight) and nonoperational (e.g., aspect, elevation.), soil available water capacity ($r^2=0.51$), slope position ($r^2=0.52$), and percent silt ($r^2=0.40$) were identified as major factors influencing herbaceous species distribution. A continuum appeared when presence data for twenty-eight herbaceous species were plotted along a moisture gradient developed by sequencing forest community types (e.g., *Quercus prinus*, *Q. stellata*, ..., *Acer saccharum*)

- 187 MCCOY ROGER A. AND PHILIP A. ROBERTSON. Department of Plant Biology, Southern Illinois University at Carbondale. Community types of Atwood Ridge, Research Natural Area, Union County, IL.

Data were obtained in eighty permanent .04 ha circular plots at Atwood Ridge, RNA to provide a basis for ecosystem monitoring. Site characteristics were related to species compositional types. Ten dominance types based on tree basal area were determined by an agglomerative clustering technique (COMPAH). These include mixed hardwoods, hill prairie, red, black and white oak, sugar maple, beech, chestnut oak, and chestnut oak-red oak types. Environmental variables measured included slope angle, aspect, position, exposed rock, and terrain shape and landform indices. Significant discriminators of the ten dominance types included slope angle ($p \leq .0001$), percent rock ($p \leq .0001$) and landform index ($p \leq .003$). Communities with the highest slope angle were chestnut oak, red oak, and chestnut oak-red oak, while those with a low landform index (less protection from surrounding ridges) included black oak, post oak and hill prairie. The chestnut oak-red oak community had the highest landform index followed by the beech and mixed hardwoods community. The chestnut oak community had the highest percent rock while the red oak and hill prairie communities had no rock. White oak and sugar maple communities were in areas of moderate landform index and slope angle. This project was funded by the U.S. Forest Service.

- 188 BARDEN, LAWRENCE S. Department of Biology, University of North Carolina at Charlotte, Charlotte, NC 28223 - Historic prairies in the Piedmont of North and South Carolina.

From 1540 to 1750, European explorers and traders in the Piedmont region of North and South Carolina reported many prairie-like openings, ranging in size up to 40 km across. However, historical evidence of Piedmont prairies has been inaccessible to most restorationists and land managers. This review summarizes historical information on prairie landscapes of the Carolina Piedmont region at the time of European-American exploration and settlement. Historical and meteorological evidence suggests that these prairies were primarily the products of Native American burning and agriculture.

- 189 FRANKLIN, SCOTT B.¹, AND PÄIVI PAALAMO². ¹Southern Illinois University, Carbondale and ²Karelian Institute, Section of Ecology, University of Joensuu, Finland--Field and bottom strata spatial patterns in an old-growth *Myrtillus* forest, North Karelia, Finland.

Small-scale patterns of the field and bottom strata within two study sites were researched in relation to site history; one study site had a history of slash-and-burn agriculture prior to 1900 while the other escaped slash-and-burn cultivation. *Dicranum polysetum*, *Pleurozium schreberi*, and *Hylocomium splendens* had pattern scales between 1.7 and 6.4 m. There was an inverse relationship between *P. schreberi* and *H. splendens*, but the underlying mechanism was unclear. The relationship may imply interspecific competition, but there was no evidence for this explanation. The inverse relationship may simply have been due to stochastic establishment with subsequent preemption. Litter cover and substrate variables (e.g. mineral soil, rock) also had small-scale patterns. Vegetation data were in some cases related to substrate and litter cover variables, but the relations were species specific; *P. schreberi* appeared to have the greatest inter-dependence. *Vaccinium myrtillus* had small-scale pattern (2.7 m) for a site which had been in slash-and-burn agriculture, but the pattern scale at a site without slash-and-burn disturbance was much greater (17.3 m). Indeed, all species patterns were greater for the site which had not witnessed slash-and-burn cultivation, reflecting the indirect and direct effects of site history. The greater overstory canopy cover of the undisturbed site was a major factor determining species abundance and patterns, and masked species-site relationships. This implies a hierarchical structuring of species patterns in the field and bottom strata by edaphic characteristics and site history.

- 190 CLINE, GEORGE R., R. DAVID WHETSTONE, FRANK A. ROMANO III, STEVEN J. THRELKELD, JASON R. ADAMS, AND ERIC A. BLACKWELL. Jacksonville State University, Jacksonville, AL - Quantitative analysis of selected northeastern Alabama tree communities: topographic effects on Fort McClellan, Calhoun County

Fort McClellan is located in the Ridge and Valley Province of the Appalachian Highlands Region in northeastern Alabama. It was first purchased by the Army in 1915, and it has been used for a variety of military activities ever since. Topographically, the Main Post lies on the western slopes of the Choccolocco Mountains. Elevations range from about 200m (650 ft) to 627m (2039 ft). This area has been proposed as a green space in the upcoming base closure process. The area supports longleaf pine communities and is potential Red-cockaded Woodpecker habitat.

For this study, we set up transects on the southeastern ridge and shoulder slopes of Mount Royal, Davis Hill, Silver Ridge, King Hill, and the Skeleton Mountains in the south, and Moorman and Mokeley Hills in the north. These transects were about 5000m apart. Ten study plots were established along each of these transects. Each 20m x 50m study plot was subdivided into 10, 10m x 10m subplots for analysis of tree communities. Relative Abundance, Relative Dominance, Relative Frequency, and Importance values were calculated for each species. Communities were named using the 69% Cumulative Importance Value method. Community Similarity was measured using the modified Nei's Index. This study is part of research supported by a NASA EPSCoR grant to Alabama Space Grant and JSU.

- 191 ROBERT E. CARTER, JR., MARK D. MACKENZIE, AND DEAN H. GJERSTAD. School of Forestry, Auburn University--Integrated land classification in the uplands of the Southern Loam Hills of south Alabama: longleaf pine ecosystems.

An integrated landscape scale classification of ecosystems was undertaken on the Conecuh National Forest and Solon Dixon Forestry Education Center in south Alabama. The classification procedure follows the hierarchical framework of ecological units developed by the US Forest Service. Following this procedure, the three landtype associations in the study area were the Pine Hills, Dougherty Plain, and Wet Pine Flatwoods. By interrelating soils, vegetation, and landform variables, two to four landtype phases (LTPs) were identified in each LTA. The major environmental variables distinguishing the LTAs were landform index, A and B horizon depths, A horizon Ca, A horizon silt, B horizon sand, and the presence of the water table in the upper 203 cm of the soil solum. Within each LTA, two to four landtype phases were identified along an environmental gradient from xeric to mesic. The diagnostic variables in the Pine Hills were

landform index, slope, B horizon depth, B horizon N, A horizon fine sand, and A horizon silt. Dougherty Plain diagnostic variables were depth to mottling, B horizon fine sand, and A horizon Ca. In the Wet Pine Flatwoods, the diagnostic variables were slope, depth to mottling, B horizon clay, drainage class, and the presence of the water table in the upper 203 cm of the soil solum. Identifying and describing these ecological units will aid in the management and restoration of longleaf pine ecosystems.

192 COULLING, PHILIP P. University of North Carolina at Chapel Hill - A comparison of plant species richness patterns in high-elevation *Quercus rubra* forests in Shenandoah National Park and the George Washington National Forest, Virginia.

Although quantitative descriptions of species richness in forests are not uncommon, few studies have compared richness across land units within a regional landscape. This study compares species richness patterns in *Quercus rubra* forests in two federal lands in the Northern Blue Ridge Mountains of Virginia and correlates differences in richness with differences in edaphic and other site conditions, land-use and disturbance histories, and population densities of deer. Preliminary observations had suggested that on similar sites richness in Shenandoah National Park (SNP) is lower than that on the George Washington National Forest (GWNF). Data from permanently marked plots reveal that while both areas have similar maximum values for species richness, characteristics of the most diverse sites differ; richness peaks on sites underlain by basaltic (mafic) parent material in SNP and on base-rich granitic (felsic) rock on the GWNF. On the most species-poor sites, however, richness is lower in SNP than on the GWNF. These sites include (1) stands with open fern-dominated understories, and (2) stands with high cover of Ericaceous shrubs; both occur predominantly on base-poor granitic parent material. Total fern and total Ericaceous shrub cover are both significantly negatively correlated with species richness. In SNP these species-poor sites include stands with the most severe mortality of gypsy moth-defoliated trees, yet within a site richness is not correlated with percent overstory mortality. This result suggests that recent mortality has not affected species richness and that higher deer densities or more intense past human disturbance are a more likely cause of the lower species richness of SNP stands.

193 BOOTH, ROBERT K., DONALD J. DRAPALIK and FREDRICK J. RICH. Georgia Southern University-Identification, and paleoenvironmental and paleoecological implications of a Late Pleistocene fossil fern spore from St. Catherines Island, Georgia.

Palynology is the study of modern and fossil pollen and spores. During palynological analysis of a Late Pleistocene/Holocene sediment core from St. Catherines Island (31 37'N latitude, 81 09'W longitude), Georgia, a monolete pteridophyte spore was found to represent 80% of the pollen/spore composition. During the fossilization of the fern spores, the perispore, or the outermost layer which is typically the most distinctive feature of monolete spores, was destroyed. The sediment containing the spores was a brown peat which was found at a depth of 5.02-5.12 meters, and was radiocarbon dated at approximately 28,000 years old. How much cooler it was 28,000 years ago along the Georgia coast is uncertain; but it is certain that because of the presence of continental ice sheets and because sea level at that time was much lower than at present, St. Catherines Island was then part of the mainland. The associated pollen/spore composition of the sediment was used to define the probable habitat and environmental preferences of the fossil fern; these preferences were used in combination with mean spore size comparisons to modern fern taxa (due to perispore absence) to identify candidates for the monolete spore producing fern (e.g. *Woodwardia*, *Thelypteris*, *Dryopteris*). Paleoenvironmental and paleoecological implications are inferred by the identification of this Late Pleistocene fern population and associated taxa (*Chenopodiaceae*/*Amaranthaceae*, *Asteroidae*, *Poaceae*, *Ambrosia*, *Pinus* and *Quercus*).

194 COFFER, NATALIE J. AND JEFFREY A. BUTTS. Appalachian State University- The prevalence of Heartworm in domestic and feral dogs in Watauga County.

Data on the prevalence of *Dirofilaria immitis* in feral and domestic dogs in Watauga County, North Carolina, were collected to determine if either group exhibited a higher prevalence of infection. Blood samples from feral dogs housed by the Watauga County Humane Society and Animal Control facilities were tested for heartworm antigen with the IDEXX Canine Heartworm Antigen Test (IDEXX Laboratories, Westbrook, ME). An additional 1-2cc of blood from feral dogs were stored in Knott's solution and later examined for microfilariae. Cooperating veterinarians in Watauga County supplied records of heartworm tests performed on domestic dogs during the same time period. Initial data indicated that the prevalence of heartworm was 5.17% in strays and 2.49% in domestic dogs. Data from domestic dog records suggested that non-resident pets made up the majority of the positive-tested domestic dogs. Pet records were examined to determine if either resident or non-resident pets could be associated with a higher prevalence of heartworm while the

survey of feral and pet dogs continued. Data were examined using a Chi-square contingency table. Current data suggests that non-resident pets may be associated with a higher prevalence of heartworm.

- 195 BLAGBURN, BYRON L.,¹ JOY L. VAUGHAN,¹ JAMIE M. BUTLER,¹ DAVID S. LINDSAY,¹ and THOMAS A. MILLER,² Auburn University¹ and Virbac, Inc.²--The entomopathogenic fungus, *Beauveria bassiana*, inhibits development of insectary-reared cat fleas, *Ctenocephalides felis*.

Beauveria bassiana is an entomopathogenic fungus that has been shown to be an effective biological control agent for certain insect pests. We herein report results of evaluation of spores of *B. bassiana* as potential biological control agents for pre-adult stages of the cat flea, *Ctenocephalides felis*. Spores were added to vessels (n=5/treatment or control group) containing artificial flea growth media at rates of 10^6 , 10^7 or 10^8 spores per ml of diluent. Equal volumes of diluent without fungal spores were added to control vessels. Twenty-five flea eggs obtained 1-2 hours previously were placed in each of the treated and control vessels. All vessels were placed in an insectary maintained under conditions known to support flea development. Twenty-eight days after egg placement and treatment, adult fleas that emerged from eggs set in each vessel were counted. Containers to which *B. bassiana* spores were added at the rate of 10^6 and 10^7 /ml of diluent harbored 46% and 74% fewer adult fleas than control vessels. Vessels containing the higher concentration of spores were apparently too moist to support development of *C. felis* because adult fleas were not recovered from either spore-treated or diluent-treated containers. Studies are under way to determine the mechanism(s) by which *B. bassiana* exerts its effects on *C. felis*.

- 196 JONES, ROBERT M.¹ AND LAURA J. FIELDEN,² Dept. Chemistry¹ and Dept. Biology², Berry College, Mount Berry, GA 30149 - The effect of blood feeding on respiratory gas exchange in ticks.

This study investigated the effect of blood feeding on respiratory gas exchange in the dog tick *Dermacentor variabilis*. Adult male and female ticks were fed on bovine hosts from 1 to 11 days. Females fed slowly for the first seven days and then rapidly engorged on blood two to three days prior to dropping from the host. Ticks were removed at daily intervals during feeding, weighed and CO₂ emission measured at 25°C using flow-through respirometry to determine standard metabolic rate ($\dot{V}CO_2$) and ventilation patterns. During feeding, females showed a dramatic gain in mass from 5.72 ± 0.76 mg to 520.80 ± 103.79 mg (n=15) while $\dot{V}CO_2$ increased from 0.0010 ± 0.0007 ml h⁻¹ to 0.0866 ± 0.0044 ml h⁻¹. Ventilation at the start of feeding was highly discontinuous with discrete bursts of CO₂ emission every 12 minutes but changed to continuous sustained CO₂ output during rapid engorgement. In contrast to females, male ticks showed little change in mass and maintained discontinuous ventilation throughout the 11 day attachment period on the host, indicating little feeding activity. The switch from discontinuous ventilation to continuous ventilation in female ticks during feeding is correlated to an increase in metabolic expenditure rather than any factor relating directly to maintenance of water balance.

- 197 MEADER, LISA L.,¹ JONATHAN M. SLEEMAN,² ANTOINE B. MUDAKIKWA,² and SHARON PATTON,¹ University of Tennessee¹ and Mountain Gorilla Veterinary Center²-- Prevalence of gastrointestinal parasites in gorillas from the Virunga Mountains in Kigali, Rwanda, Africa.

Preserving the Mountain Gorilla in its natural habitat depends on learning more about the gorillas, particularly how well they have survived the war in Rwanda and the refugee crises in Zaire. In conjunction with ecological and health studies of the gorillas (*Gorilla gorilla*) of the Virunga Mountains in Rwanda, Africa, 70 fecal samples were collected by the Mountain Gorilla Veterinary Center from 61 gorillas. Feces were preserved in both 10% formalin and PVA and sent to the University of Tennessee Clinical Parasitology Laboratory for analysis. Samples were examined using the centrifugal flotation procedure with two solutions: zinc sulfate (sp.g.=1.180) and Sheather's Sugar (sp.g.= 1.275). All fecal samples were positive for one or more parasites. The parasites identified were: *Oesophagostomum* sp. (70/70), *Anoplocephala* sp. (60/70), *Probstmayria* sp. (6/70), coccidia (5/70), *Entamoeba hartmanni* (5/70), *Endolimax nana* (1/70), *Trichuris trichiura* (1/70), ascarid-type egg (1/70), psoroptid-type mite (1/70), and an unidentified mite (1/70). To our knowledge, there are no previously reported cases of ascarids or *Trichuris trichiura* in gorillas of the Virunga Mountains. Because these parasites also infect humans, we suspect that the gorillas are in contact with human feces. Information about the parasites in this gorilla community contributes to an understanding of the health of the community and the range, distribution, and zoonotic potential of parasite species.

- 198 FAULKNER, CHARLES T.,¹ C.S. MAYES,¹ S.E. COWIE,² P.E. MARTIN,² and SHARON PATTON,¹ University of Tennessee College of Veterinary Medicine¹ and Michigan Technological University²-Examination of privy deposits from the 19th century company town of Fayette, Michigan (20DE19) for endoparasitic infection.

Archaeological deposits from the 19th century company town of Fayette, Michigan (20DE19) were analyzed for the presence of endoparasitic helminth eggs, larvae, protozoan cysts, and oocysts. Latrine sediments associated with 2 skilled-worker's dwellings were positive for eggs of *Trichuris trichiura*. Latrine sediments associated with the superintendent's house, and refuse disposal loci associated with 2 unskilled worker's cabins were negative for endoparasitic infection. *T. trichiura* eggs are commonly found in the privy deposits of archaeological sites in the United States. Human infections are associated with fecal contamination of the environment and poor hygienic behavior. The results of this study indicate that *T. trichiura* was established in the human population inhabiting this 19th century town. Epidemiologic studies of modern human populations support the assertion that *T. trichiura* infections may have been common among 19th century children given their inclination to play in the dirt, eat without adequate hand washing, and defecate freely in the environment.

- 199 MOHAMED, FAWZI¹, JOSÉ V. de SANTANA², ELIZABETH MALAGUEÑO², ADRIANA TELLES², VLAUDIA COSTA², NADJAR SILVA², DANIEL J. MURFIN¹, AND RAYMOND T. DAMIAN¹. ¹Department of Cellular Biology, University of Georgia, and ²Laboratório de Imunopatologia Keizo Asami, Universidade - Federal de Pernambuco, Brazil- Experimental *Schistosoma mansoni* infection in the common marmoset (*Callithrix jacchus*).

Twenty four adult common marmoset monkeys (*Callithrix jacchus*) were each exposed to 150-450 cercariae of *Schistosoma mansoni* (Brazilian SLM or BH strains), 12 by percutaneous and 12 by the subcutaneous routes. Fecal examinations, tissue egg counts, and adult worm recoveries were performed. Liver, lungs, intestines and spleen were collected and processed for histopathology. All but 2 of the animals used in this study became infected. Average worm recovery was 38%. Only 4 of 18 animals tested had positive fecal examinations for *S. mansoni* eggs, but most of them had worms and histopathological evidence of oviposition. Perfused worms were mostly unpaired. The histopathological examination revealed periovular granulomas in the liver, lungs, and intestines. The granulomas were variable in size and at different stages of development. They consisted mainly of a centrally localized egg surrounded by lymphocytes, macrophages, and eosinophils. Fibrosis was not a prominent feature. No obvious trend was noticed to indicate variation in the pathology of the disease according to route of infection or the strain of *S. mansoni* used. The results suggest that the common marmoset is initially permissive for *S. mansoni*, but may subsequently become nonpermissive, as evidenced by unpairing of the worms and reduction in fecal eggs. Supported by Brazilian agencies: FINEP (No. 66.920454.000) and CNPq-PROPESQ-UFPE.

- 200 CHOU, TIEN-MIN, ROGER W. STICH, JACEK GAERTIG, CHRISTINE MARSALA, FAWZI MOHAMED, AND RAYMOND T. DAMIAN. Department of Cellular Biology, University of Georgia - Development of a Molecular Probe for Baboon Interleukin-10 to Study Experimental Schistosomiasis

Schistosomiasis is a major parasitic disease of humans. Baboons (*Papio cynocephalus*) are good models for the study of human schistosomiasis. Eggs in host tissues are believed to be the primary cause of pathology in both acute and chronic schistosomiasis in animal models and humans. We propose that interleukin-10 (IL-10) is differentially expressed in egg granulomas that are formed in host tissues during acute and chronic schistosomiasis. A single-stranded DNA probe has been developed for the measurement of IL-10 expression in baboons during experimental schistosomiasis. Peripheral blood mononuclear cells were isolated from a baboon by density gradient centrifugation, and stimulated with Con A for 8 hours prior to RNA extraction. IL-10 cDNA was amplified from the total RNA by reverse transcription followed by the polymerase chain reaction (RT-PCR), with degenerate oligonucleotide primers designed from a multiple mammalian species sequence alignment of IL-10 protein sequences. Cloning and sequencing of the PCR product confirmed that it is of baboon IL-10 origin. Future study of IL-10 expression during experimental schistosomiasis in the baboon model will be discussed. RWS was supported by USPHS NIH Training Grant (5 T32 AI07322).

- 201 CONNORS, VINCENT A.,^{1,2} ISAURE DE BURON,² JOSÉ JOURDANI,¹ ANDRÉ THIÉRON, WILLARD O. GRANATH,² AND ANNE AGNER,² University of South Carolina, Spartanburg,¹ University of Montana, Missoula,^{1,2} and University of Perpignan²-Interleukin-1 mediated killing of *Schistosoma mansoni* primary sporocysts in susceptible strains of the snail host, *Biomphalaria glabrata*.

Previous work on the *Schistosoma mansoni*/*Biomphalaria glabrata* system has indicated the presence in the snail of a molecule with immunological, biological, and functional similarity to the human cytokine,

interleukin-1 (IL-1). Further, supplementation of the snail's IL-1-like molecule (Snail-1) with recombinant human IL-1 (rhIL-1) has been shown to activate cytotoxic mechanisms in the host's blood cells (hemocytes) and this activation is followed by a significant decrease in the number of cercariae shed from normally susceptible snails. The work presented here used a combination of histological and cytotoxicity assays to determine if injection of rhIL-1 into snails from the M-line and Brazilian Albino strains of *B. glabrata* resulted in the killing of primary sporocysts in these otherwise highly susceptible hosts. Significant decreases in the number of primary sporocysts present in injected snails relative to sham injected controls were observed at 15 days PE in each strain. Because no hemocytes were found encapsulating dead parasites at 3 days PE, because rhIL-1 supplemented plasma killed parasites *in vitro* in the absence of hemocytes, and because rhIL-1 is not itself toxic to the sporocysts, these results indicate that IL-1 stimulates an early non-cell mediated killing of primary sporocysts in these otherwise highly susceptible intermediate hosts.

- 202 PAULEY, THOMAS K. Department of Biological Sciences, Marshall University, Huntington, WV-
Study of a relocated population of *Plethodon nettingi* Green.

In 1981 an area with a population of *Plethodon nettingi* (Cheat Mountain salamander) was designated to be disturbed by the development of a coal mine in the Monongahela National Forest, West Virginia. The National Forest owned the surface rights but a private company owned the mineral rights which allowed the construction of the mine. In an attempt to save this population, I removed 47 *P. nettingi* and relocated them to a site approximately 2.8 miles west. The relocation site was on Cheat Mountain approximately 3.0 miles north of the type locality. This site had been surveyed for the Cheat Mountain salamander in 1980 and again in preparation for the relocation. This latter survey was conducted during a rainfall in day and night surveys on June 24 and 25, 1981. The Cheat Mountain salamander was not found. Salamander species that were considered to be competitors were removed. *Plethodon nettingi* was collected from the mining site during a rainfall in day and night surveys from June 23 to 25. Specimens were measured for snout-vent length and released at 10 sites in groups of 5 except for the tenth site where 2 specimens were released. All specimens were placed at the base of trees to allow for maximum soil moisture from stem flow. Follow-up surveys were conducted for the ensuing 4 years (1982-1985) at night during summer months and within 24 hours of a rainfall. Thirty-nine salamanders, 19 *P. cinereus* and 20 *P. wehrlei*, were observed in these four years. *Plethodon nettingi* was not found. The area was left undisturbed until 1994 when I surveyed the area again at night during a rainfall. Only *P. cinereus* (10 specimens) and *P. wehrlei* (3 specimens) were found.

- 203 TUCKER, ROBERT B.¹, THOMAS K. PAULEY¹, AND JOSEPH C. MITCHELL².¹ Marshall University, Huntington, WV 25755 and ²University of Richmond, Richmond, VA 23173- Notes on the natural history and ecology of *Plethodon punctatus* Highton.

Forty-nine sites on Shenandoah Mountain were surveyed for *Plethodon punctatus* (Cow Knob salamander) from May through October, 1995 and 1996. *Plethodon punctatus* were found in 16 of 27 sites on the west side of the mountain and in 6 of 22 sites on the east side. Surveys involved time-constrained searches during the day and involved 27 person-hours of searching on the west side and 45.5 person-hours on the east side. Data collected included litter moisture, cover objects, reproductive biology, and prey items. More salamanders were found under rocks (76.5%) than logs (23.5%). The average size of rocks was 34.5 cm long x 18.9 cm wide x 6.7cm thick. Analyses of follicles and sperm waves showed that spermatophore deposition and egg deposition occurs in April and May. Prey items from May through August consisted of invertebrates including 15 insect orders. Dominant prey items were hymenopterans, coleopterans, and acarins.

- 204 PIASCIK, JENNIFER AND THOMAS K. PAULEY. Department of Biological Sciences, Marshall University, Huntington, WV 25755 - Natural history notes of *Notophthalmus v. viridescens* in West Virginia.

Notophthalmus v. viridescens (red-spotted newt) is one of the most common salamanders in the northeast United States. Studies have not been conducted on its natural history in West Virginia. We examined a population of newts in southwestern WV and museum specimens from other parts of the state to determine reproductive biology, seasonal activities, and population structure. Analyses of sperm wave and follicle development showed that mating generally occurs from November to April. Eggs hatch from June through August and larvae transform in August and September. Seasonal movement studies indicated that newts start to migrate to breeding ponds in November and leave ponds in April and May. Studies with funnel traps showed a 27:1 sex ratio in February and March and 1:2.5 ratio in June and July.

- 205 ¹Paxton, Barton J., ¹Thomas K. Pauley, ²Stephen B. Horsley and ²David Decalesta. ¹Marshall University, Huntington, WV 25755 and ²Northeastern Forest Experiment Station, Warren, PA 16365. Effects of lime, deer exclusion and herbicide on terrestrial salamanders in the Susquehannock State Forest, Pennsylvania.

Four replicates, each containing eight 0.9 acre plots, were established in the Susquehannock State Forest in Potter County, Pennsylvania in 1985. In each of the four replicates; four plots were protected with an electric fence, four plots received dolomitic limestone at a rate of 5 tons per plot, and four plots were sprayed with Roundup at a rate of 2 pounds per plot. This procedure resulted in eight different treatment plots. In 1995 four sets of 12 (15cm x 25cm) hemlock boards were placed in each treatment plot. Boards were laid directly upon the forest floor to act as artificial cover objects. Boards were checked biweekly from the beginning of June 1996 to the end of August 1996. Biological data collected included snout-vent length, cranial width, sex and mass. All salamanders were toe clipped and released to facilitate mark recapture studies. Environmental data collected included leaf litter mass, leaf litter moisture, soil moisture, soil pH, soil temperature, air temperature, relative humidity, and canopy cover. A small sample of salamanders were collected from each plot type for reproductive and fat analyses. Plots that received dolomitic limestone in 1985 continue to have a significantly higher soil pH than those that were not treated.

- 206 MITCHELL, JOSEPH C. Dept. of Biology & School of Continuing Studies, Univ. of Richmond, VA 23173. Monitoring amphibians in the Blue Ridge Mountains of Virginia: effects of acidification and floods.

The effects of acidification and habitat loss were studied in three Blue Ridge Mountain streams in Shenandoah National Park (SNP), Virginia 1994-1996. They represent an alkalinity gradient from low acid neutralizing capacity (ANC, Paine Run), to moderate ANC (Staunton River), to high ANC (Piney River). I monitored amphibian communities by time-constrained visual encounter surveys and linear transects with randomly placed m² quadrants. I found a total of 15 species of amphibians (8 frogs, 7 salamanders): Paine Run (14), Staunton River (9), Piney River (8). Numbers of fish and invertebrates show opposite trends. The difference may be related to amphibian pH tolerance limits (no pH was below 5.0) and the abundance of optimal habitat in Paine Run. Densities of streamside salamanders were similar among streams. On 27-28 June 1995, 53 cm of rain fell over the lower Staunton River. Post-flood salamander densities decreased from pre-flood densities, but no species was extirpated from the watershed. At least four species of frogs attained successful reproduction in the backwaters and pools in this stream in 1996, whereas only one species (*Rana clamitans*) was present before the flood. Conclusions: The acidity of these mountain streams have not yet reached levels that are intolerable by the amphibians inhabiting them. Major flood events in mountain streams do not always eliminate streamside salamanders. (3) Natural flood events can modify the species composition of amphibian communities through massive habitat alteration.

- 207 ADAMS, JASON R. AND GEORGE R., CLINE. Jacksonville State University, Jacksonville, AL - Preliminary of the amphibians and reptiles of Fort McClellan, Calhoun County, Alabama.

Fort McClellan is located in the Ridge and Valley Province of the Appalachian Highlands Region in northeastern Alabama. It was first purchased by the Army in 1915, and it has been used for a variety of military activities ever since. Topographically, the Main Post lies on the western slopes of the Choccolocco Mountains. Elevations range from about 200m to 627m. The topographical diversity in conjunction with limited access has allowed a wide range of plant communities to develop. This area has been proposed as a green space in the upcoming base closure process.

Amphibians and reptiles were collected using various survey techniques: road cruising, drift fences, hand capture, seining, and frog call analysis. To date, we have collected 24 species of amphibians and reptiles. These are broken down as follows: 10 anurans, 6 caudatans, 2 lacertilians, 3 ophidians, and 3 chelonians. These data will be discussed relative to community types.

- 208 ERIC A. BLACKWELL AND GEORGE R. CLINE. Jacksonville State University, Jacksonville, AL - A preliminary study of salamander population dynamics at a northeastern Alabama pond.

Salamander communities are structured to minimize niche overlap. The breeding seasons of three salamander species were studied over one year at a small pond in northeastern Alabama. *Ambystoma*

opacum is a Fall breeder. Adults arrived at the study pond in early Fall, and leave before Winter. Larvae persist in the pond through May. Approximately 30 breeding adults entered the pond during this study, while 52 juveniles left the area. Ambystoma maculatum is a Winter/ Spring breeder. Adults arrived in early winter and leave in early Spring. Metamorphic individuals leave between June and October. Approximately 250 breeding adults visited this pond, but only 62 juveniles left the pond. Notophthalmus viridescens adults arrive in October and November and remain there for the rest of their lives. Metamorphic individuals leave the pond during September. Approximately 30 breeding adults inhabit the pond, and 23 juveniles left the pond. The ratio of size at metamorphosis to average adult size was calculated for each species. This might be used as an index of the probability of postmetamorphic survival. Possible confounding factors are discussed.

- 209 LAPP, KEVIN D. AND R. W. VAN DEVENDER. Appalachian State University, Boone, NC 28608 - Seasonal Activity of a Terrestrial Salamander Community in Northwest North Carolina

Plethodon wehrlei reaches the southern limit of its range at two isolated North Carolina sites, including Saddle Mountain on Surry/Alleghany county border. Seasonal activity of terrestrial salamanders at the Saddle Mountain site was monitored from May 1996 to the present. Two transects were visited at night and searched for salamanders at least once a month throughout the active season for terrestrial salamanders. Salamanders were measured, toe-clipped, and released at site of capture. Sex and reproductive status were also recorded. Recaptures provided data on movement and population sizes. Salamanders observed were *Notophthalmus viridescens*, *P. wehrlei*, *P. yonahlossee*, *P. cylindraceus*, *Desmognathus monticola*, and *Eurycea wilderae*. Surface activity varied among species. Adult *P. wehrlei* were active only in the spring and fall, but juveniles remained surface active into early summer. *P. cylindraceus* and *P. yonahlossee* were active during the entire season. The few specimens of *N. viridescens* were active in the spring and summer while *E. wilderae* and *D. monticola* were seen in the fall. Data will be presented on community structure throughout the year and factors correlating with surface activity of each species.

- 210 BUHLMANN, KURT A. University of Georgia's Savannah River Ecology Laboratory - Reproductive biology and ecology of the chicken turtle *Deirochelys reticularia*.

The chicken turtle is an inhabitant of seasonal and fluctuating wetlands of the southeastern United States. Chicken turtles have several unusual life history and natural history traits relative to other sympatric turtle species. These traits include an autumn-winter nesting period and the ability to retain oviductal eggs for extended periods of time. Because chicken turtles begin nesting in autumn, the ability to retain eggs over the winter period may be a response to unsuitable nesting conditions. However, do retained eggs have the same hatching success as directly deposited eggs? Therefore, I monitored 31 nests of chicken turtles for hatching success and time of hatchling emergence. Of the 31 clutches, 14 were autumn-deposited, 11 were retained by the female from autumn until deposition the following early spring, and 6 represented spring-deposited second clutches. Clutch size, egg size, hatching success, hatchling size, and time of emergence from the nest are compared among the clutch categories. The possible evolutionary significance of this reproductive strategy is discussed.

- 211 MORROW, JESSICA L. AND JAMES HOWARD Dept Biology, Frostburg State University, Frostburg, MD 21532-Home range and movements of the bog turtle, *Clemmys muhlenbergi*, in Harford County, Maryland.

Bog turtles (*Clemmys muhlenbergi*) are considered one of the rarest semi-aquatic species in the United States. Due to declining populations in Maryland (which may support the largest populations in the nation), this species is under consideration for federal listing. To create effective conservation strategies that will facilitate the recovery of bog turtle populations, detailed information about their home ranges and movements is needed. Therefore, we initiated a study of bog turtle populations at two sites (HA406 and HA411) in Harford County, Maryland. Using radiotelemetry, we recorded the locations of 17 turtles at HA406 and 15 turtles at HA411 twice a week from early May to late August 1996. We obtained an average of 27 locations for each turtle. Home range sizes and average daily distances traveled were determined using the Adaptive Kernel

Method provided in the CALHOME computer program. The approximate sizes of wetlands HA406 and HA411 were 2224 m² and 1577 m² respectively. The size of male home ranges (1076 ha) were not significantly different from female home range sizes (988 ha). Average daily distances traveled did not statistically differ between males (3.68 m/day) and females (3.21 m/day). Lastly, home range sizes were significantly larger at HA406 (3251 ha) than HA411 (815 ha). This suggests that given a larger wetland (HA406) turtles had larger home ranges.

212 DILLS, MELISSA D.,^{1,2} WILLIAM K. MICHENER,¹ AND CRAIG GUYER.² J.W. Jones Ecological Research Center¹ and Auburn University²--Dispersion of *Gopherus polyphemus* burrows with regard to microhabitat parameters in a longleaf pine ecosystem.

Gopher tortoise (*Gopherus polyphemus*) burrow densities were examined across a soil moisture gradient on the Ichauway preserve in Baker County, Georgia. Densities were highest in mesic (7.1/ha) and xeric (6.2/ha) habitats and lowest in hydric (2.5/ha) habitats. Microhabitat parameters (canopy cover, basal area, slope, soil and groundcover vegetation) were examined at 48 burrow sites and 50 randomly-located control points within a 50 ha mesic site dominated by longleaf pine (*Pinus palustris*). Canopy cover, pine basal area and slope differed between burrows and control points, suggesting that tortoises locate burrows by cueing in to these parameters. Canopy cover was closely related to basal area ($r^2=0.39$). Soil and groundcover vegetation did not differ between control points and the back of burrows, but differed between control points and the front and sides of burrows. Soils were more compact in plots located at the front and sides of burrows. Broad-leaved grasses (Graminae) and low-bush blueberry (*Rubus*) were less abundant in plots located in front of burrow entrances, whereas legumes (Fabaceae) were more abundant. These results indicate that tortoises may not locate burrows by specifically cueing in to soil and groundcover vegetation, but do play a role in modifying microhabitat once burrows have been established.

213 MILLS, MARK S. Department of Zoology, University of Georgia, and Savannah River Ecology Laboratory, Drawer E, Aiken, SC 29802 - Demography and growth of the brown water snake, *Nerodia taxispilota*.

From 1991 to 1996 I captured ca. 1200 brown water snakes in the Savannah River and its tributaries on the Savannah River Site, South Carolina. The recapture rate was approximately 10%. The overall sex ratio was 1:1 and the adult sex ratio was 3:2 (1.53 males to 1 female). Based on size, males reached maturity in 2-3 yr. and females reached maturity in 5-7 yr. Growth rates of recaptured snakes (1-3 recaptures/snake; mean = 1.2 recaptures/snake) indicated that growth slows after individuals reach maturity. Juvenile males and females grew at mean rates of 0.32 and 0.43 cm/week, respectively, and adults grew at 0.17 and 0.31 cm/week. Based on growth rates, I have captured individuals that were at least 11 yr. old and some could be as old as 20 yr. Concurrent radiotelemetry studies have shown that this species is highly mobile (i.e., can move > 200 m/d) and will often use nonriverine habitats for various periods of time. Thus, many individuals in the population were not available for capture during any given collecting trip. This information coupled with the low recapture rate indicates that previous population estimates for this area (43 individuals per km of river) are probably low.

214 MATTER, JOHN M., CYNTHIA SILLS-M^cMURRY AND RICHARD L. DICKERSON. Department of Environmental Toxicology, TIWET, Clemson University, Pendleton, SC 29670 - Xenobiotic contaminants alter sex determination of *in ovo*-exposed American alligators (*Alligator mississippiensis*).

Animals exhibiting temperature-dependent sex determination (TSD; crocodilians, most turtles and some lizards) do not possess heteromorphic sex chromosomes. Sexual development is regulated by incubation temperature acting through differential expression of gene loci responsible for aromatase synthesis. Conversion of testosterone to 17 β -estradiol (an event mediated by aromatase) is responsible for differentiation of embryonic gonads to form ovaries. Several agricultural pesticides and industrial pollutants have the potential to bind hormone receptors and influence steroid concentrations during embryonic development. Animals exhibiting TSD may serve as model organisms for evaluating the potential for certain xenobiotic compounds to influence reproductive differentiation during development. We exposed alligator embryos to several xenobiotic compounds (alone and in binary combinations) during incubation and examined sex ratios and gonadal morphology in hatchlings. Compounds examined were: 1) 2,3,7,8 tetrachlorodibenzo-*p*-dioxin (TCDD), 2) ethynyl estradiol (EE), 3) *o,p'*-DDE, 4) *p,p'*-DDE, 5) coumestrol (Coum) and 6) indole-3-carbinol (1-3-C). Estrogenic activity was exhibited by EE, Coum and *o,p*-DDE, evidenced by their ability to produce female hatchlings at male-producing incubation temperatures (33 C). All eggs treated with *o,p'*-DDE + *p,p'*-DDE produced females, indicating the possibility of *in vivo* estrogenic synergism by these two DDT metabolites. TCDD-treated alligator eggs failed to produce females when combined with *o,p'*-DDE, *p,p'*-DDE or 1-3-C, consistent with dioxin's action as an anti-estrogenic substance. TCDD induced female phenotype formation only when combined with EE.

and Courn. These data indicate that TSD may serve as an important physiological feature in assessing the potential for xenobiotic disruption of endocrine physiology and sexual differentiation.

- 215 MIDKIFF, ERICA S. AND DONALD C. TARTER. Department of Biological Sciences, Marshall University, Huntington, WV 25755 - Comparative ecological studies on the diet and growth rates of larval and juvenile grass pickerel, *Esox americanus vermiculatus*, and central mudminnow, *Umbra limi*, and fall spawning of the grass pickerel in the Green Bottom Wildlife Management Area, West Virginia.

The grass pickerel, *Esox americanus vermiculatus*, is listed as Undetermined on the Vertebrate Species List of Concern in West Virginia. The lentic, vegetated areas that are required for spawning for the grass pickerel and the central mudminnow, *Umbra limi*, are being reduced by residential, agricultural, and industrial developments. Green Bottom Swamp, a naturally occurring wetland of 58 ha, and a nearby mitigated wetland of 29 ha provides spawning habitat for the grass pickerel and the mudminnow. Fish (1994-96) were collected in beds of *Potamogeton crispus* and *Ceratophyllum demersum* from the old swamp. In December 1994, 15 pickerel were collected from beds of *Polygonum* sp. in the mitigated wetland. Between April 1995 and July 1995, 65 pickerel (6.67-101.45 mm) and 155 mudminnows (3.89-30.68 mm) were collected from the old swamp. The growth of these fish have been compared along with the diet. Stomach contents of each fish were analyzed and assigned a point value ranging from 0 (empty gut) to 30 (full gut). The percent frequency of food items were determined for each stomach. In the larval pickerel and mudminnows, cladocerans and copepods were the most abundant. In the juvenile mudminnows, the items ranged from larval chironomids and ostracods to cladocerans, while the pickerel consumed naiadal stages of large aquatic insects (odonates and corixids) and small fish.

- 216 RUSSELL, ANN M., RON C. AHLE, AND ALBERT B. PITTMAN. South Carolina Department of Natural Resources, Columbia, SC 29202 - Fish survey of pocosin habitats in the sandhills of South Carolina.

Little research has been done on fish communities occurring in pocosin habitats within the sandhills ecosystem in South Carolina. Pocosin ecosystems contain unique habitats that support unusual fish assemblages. A variety of fishes, through special physical and behavioral adaptations, are permanent residents of seepage and pond habitats. Physical adaptations allow resident fishes to utilize shallow water environments that are low in pH and dissolved oxygen. Behavioral adaptations allow resident fishes to avoid predation while utilizing nutrient resources not available to non-resident fishes. Fish assemblages found in pocosin habitats often contain rare species. The Carolina pygmy sunfish (*Elassoma boehlkei*) is an example of a species known to occur in only one location in the sandhills of South Carolina. This research involves 35 fish collections in various habitat types that include stream channels, floodplain seeps, powerline right-a-ways and ponds. Collections were made using dip nets in near shore habitats where pygmy sunfish typically occur. In conjunction with fish sampling, various water quality parameters were taken and habitat characteristics were noted. A total of 27 species representing 11 families were captured. Three species of pygmy sunfish were collected including one individual Carolina pygmy sunfish. Fish community assemblages were compared with habitat types and specific water quality characteristics. Most of the species captured occurred in one or more of the stream channel collections. However, with the exception of the banded pygmy sunfish (*Elassoma zonatum*), pygmy sunfish species occurred primarily in powerline seeps and ponds. These habitat types generally have limited canopy cover, low pH, thick vegetation including various grasses, and minimal flows. In summary, main stream channels had relatively neutral pH values and high diversity of species using the near shore habitats. Conversely, seepage pools and ponds had lower pH value with corresponding lower fish diversity. However, the seepage pools did have the greatest diversity of pygmy sunfish. This indicates that pocosin seepage habitats provide important spawning and nursery habitat as well as feeding habitat for pygmy sunfish.

- 217 SHARP, HOMER F. AND STEVE BAKER. Division of Natural Science and Mathematics, Oxford College of Emory University, Oxford, GA 30267 - Historical changes in the benthic macroinvertebrate community structure of Dried Indian Creek, Newton County, Georgia.

A survey of the benthic macroinvertebrate community of Dried Indian Creek, a 2nd/3rd order stream in the Georgia Piedmont flowing through the city of Covington, was initially conducted in 1978. The study was repeated in 1993 to compare current data with data collected in the 1978 study and to evaluate historical changes in the stream biota. Despite urban growth and increased non-point runoff since the 1978 study, the results revealed significant improvements in the invertebrate community structure as documented by differences in EPT value between years. The improvement can be linked to advances in wastewater treatment and, probably, to the influence of a small urban wetland.

- 218 MEDLAND, VICKI L. AND BARBARA E. TAYLOR, University of Georgia, Savannah River Ecology Laboratory, Drawer E, Aiken, SC 29802.- Impact of climate variability on the success of life history strategies of diapausing cyclopoid copepods.

Models of global climate change predict increased variability in weather patterns in the southeastern US in the next 100 years. In order to test the possible impact increased climate variability might have on

organisms that depend on dormancy to avoid adverse conditions, a model was constructed of the long-term success of cue-dependent dormancy strategies of crustaceans existing in temporary ponds. Initial runs of the model suggest that as variability about mean precipitation and time until next rainfall is increased, environmentally cued strategies with early reproduction are more successful than environmentally cued strategies with late reproduction. Comparisons of resource availability and water level suggest that both of these environmental cues are important in determining the success of a particular strategy. In order to test the model the species composition of cyclopoid copepods was examined in Rainbow Bay, SRS, SC between December 1989 and June 1993 and the environmental cues that determine dormancy in these copepods were identified. Results indicate important dormancy cues are temperature and total length of hydroperiod. Model runs parameterized with the Rainbow bay data indicate that species composition will shift as certain strategies are favored under increasing climate variability.

219 HOOD, ROBERT W.¹, DONALD C. TARTER¹, AND TED R. ANGRADI² ¹Department of Biological Sciences, Marshall University, Huntington, WV 25755, and ²Northeastern Forest Experiment Station, Parsons, WV 26287 - Longitudinal, vertical, and seasonal variation of the interstitial macroinvertebrate fauna at the Fernow Experimental Forest, Parsons, West Virginia.

Multi-level basket samplers were placed in the substrate on first-through fourth-order streams on the Elk Lick Run drainage at Fernow Experimental Forest, Parsons, West Virginia. Samplers were colonized by macroinvertebrates over three month intervals, collected and are in the process of being analyzed. Seasonal, longitudinal, and vertical variation in the macroinvertebrate community are being analyzed to better understand the structure and function of the interstitial macroinvertebrate and important influencing factors. Surber samples were also taken for comparison between surface and artificial basket samples. Temperature, dissolved oxygen, water chemistry, depth and surface velocities were also measured to characterize conditions at each sampler during colonization, along with seasonal inter-gravel flow measurements. Preliminary data shows most macroinvertebrates decreasing in number with depth, and the family Chironomidae increasing in relative abundance with depth. Data also shows differences in community among stream sites.

220 BRITTINGHAM, KEVIN D.¹, DONALD C. TARTER¹, AND TED R. ANGRADI². ¹Dept. of Biological Sciences, Marshall University, Huntington, WV 25755 and ²Northeastern Forest Experiment Station, Parsons, WV 26287 - A comparative study of the benthic populations in weir ponds draining watersheds of the Fernow Experimental Forest, Parsons, West Virginia.

A study on the comparison of the benthos in weir ponds draining watersheds of the Fernow Experimental Forest (FEF) was conducted in October and November of 1971 and 1994. The collection in 1971 was done by Steve Harris for his thesis work at West Virginia University. The objectives of this study were: (1) to relate differences in weir pond faunas to watershed treatments on the FEF, and (2) to compare current fauna to that described in 1973 by Steve Harris. The individuals collected were keyed to genus and densities calculated for a m². A Before-After Control-Impact (BACI) sampling design was used, in which the impact and control sites were sampled contemporaneously and repeatedly in periods before and after the perturbation of interest. A comparison was conducted on taxa density and taxa richness. The data showed that the collection in 1971 had fewer numbers but greater taxa richness when compared to the collection in 1994. Overall there are some significant differences in the weir pond populations when comparing 1971 to 1994 collection dates.

221 WILHELM, ERIC S., KEVIN D. BRITTINGHAM, ERICA S. MIDKIFF, AND DONALD C. TARTER. Department of Biological Sciences, Marshall University, Huntington, WV 25755 - Population dynamics of Chironomidae in Green Bottom Wildlife Management Area, Cabell County, West Virginia with notes on Chronomidae of West Virginia.

Chironomid larvae were collected from three separate impoundments within the Green Bottom Wildlife Management Area (GBWMA) from April 26 - August 3, 1996. One impoundment was created and is maintained by beavers (*Caster canadensis*), while two additional impoundments were created via wetland mitigation by the US Army Corps of Engineers. In spite of annual flooding by the Ohio River which temporarily joins the three wetlands, each impoundment has developed distinct vegetative and invertebrate communities. This study examines correlations between the chironomid populations of nine distinct vegetative communities occurring in the wetlands system. Eight taxa have been documented thus far, including, *Chironomus*, *Endochironomus*, *Glyptotendipes*, *Parachironomus*, *Polypedium*, *Ablabesmyia*, *Larsia*, and *Tanytus*. Distributional records and habitat information on chironomid populations throughout West Virginia will be discussed.

- 222 MAYNE, CHRISTOPHER D AND WILLIAM PEGG. Frostburg State University-
The fall turnover limnology of a man-made West Virginia lake.

A man-made West Virginia lake was sampled for four months (August - November) to provide baseline data on water quality and management practices. The reservoir was created by damming a stream for a housing development but has never been analyzed. Chemical tests indicate that the lake has neutral pH values, low chloride, nitrogen, phosphorus, and heavy metal content, as well as moderate to low conductivity levels. The presence of *Dinobryon* and other phytoplankton indicate low nutrient levels within the lake. Cladoceran species dominate the planktonic populations while copepods exist in significant numbers. *Najas minor* is the primary aquatic macrophyte and covers the entire littoral zone except for a few patches of *Typha* and *Potamogeton* species. At the present time, the lake exhibits characteristics that may not reach classical eutrophication levels. However, care must be taken to retain aesthetic values and to prevent eutrophication from residential inputs entering the lake.

- 223 HUPP, CLIFF R. AND MICHAEL R. SCHENING United States Geological Survey,
430 National Center, Reston, VA 20192 - Patterns of sedimentation and woody vegetation along black- and brown-water riverine forested wetlands.

Sediment trapping is cited frequently as a major function of riverine forested wetlands, yet little is known concerning sedimentation rates at the landscape scale in relation to site parameters, most notably patterns of woody vegetation. The Coosawhatchie River in coastal South Carolina, a black-water stream, is compared to the Cache River on the Mississippi alluvial plain in Arkansas, a brown-water stream. Sedimentation rates along each river were estimated at sites along transects normal to the channel, by measuring the amount of deposition over the major root system of age-determined trees, and related in turn to vegetation type, ground surface elevation relative to adjacent channel, hydroperiod, flow velocity, and hydraulic connection to river water. Mean deposition rates ranged from 0.02 to 0.20 cm/yr on the Coosawhatchie and from 0.20 to 0.36 cm/yr on the Cache; an expected relative difference given that brown-water streams carry substantially greater suspended-sediment loads than black-water streams. Although the present study is part of an ongoing larger program (Bottomland Hardwoods Ecosystem Initiative), preliminary results suggest that sediment trapping patterns are most closely related to sediment supply, hydraulic connectivity to river water, and flow velocity. Vegetation patterns, largely controlled by hydroperiod, most likely affect deposition rates through variation in surface roughness (stem size and density, coarse woody debris production) and thus the velocity of sediment-laden flows.

- 224 WEAVER, WARREN T. Department of Plant Biology, Southern Illinois University at Carbondale,
Carbondale Illinois 62901-6509 - Vegetation in restored and natural wetlands in the Sandhills of Nebraska.

Three wetlands restored in 1993 and three natural depression wetlands were evaluated in the summer of 1995. A total of 126 species were identified, of which 72 were found only in the natural areas and 23 only in the restored area. Cluster analysis of mean cover values identified five vegetative associations in the natural area and three in the restored. Ordination of these data resulted in a tight clustering of the restored area plots midway along a moisture gradient suggesting that the restored area represents only a subset of the communities in the natural area. This idea is further supported by the evaluation of species distributions of species that occur in greater than 10% of all plots. Twelve species (frequencies greater than 10%) showed significant differences ($p < 0.05$) between the restored and natural wetlands. Based upon community-level and species-level analysis the two sets of wetlands had a low similarity. The difficulties that are involved with restoration should inspire serious efforts to prevent the destruction of this habitat.

- 225 HAMILTON, ASHLEY K., MARK D MACKENZIE, AND B GRAEME LOCKABY School of
Forestry, Auburn University - Cumulative impacts of multiple land uses on water quality in the Sepulga River watershed of Alabama.

One important linkage in terms of nonpoint source (NPS) pollution is that of land use/cover and stream water quality. While it has been suggested that urbanization and agriculture have the most significant impacts on water quality, forest management activities associated with harvesting may also have effects. This study investigated sources of NPS pollution such as agriculture, silviculture, and urbanization in small watersheds of the Alabama

coastal plain region in the Sepulga River watershed. The major objective of the research was to relate multiple land uses at the watershed scale to NPS indices of water quality. This was achieved by identifying small watersheds and contrasting them in terms of land use/cover and water chemistry. Land use/cover patterns were generated through GIS and remote sensing, while water samples were collected in the field for chemical analysis. Preliminary data indicate that distinct differences occur among small watersheds in the study area in terms of nitrate concentrations in streams. These data range from 0.031 to 1.976 ppm; however, the relationships of nitrate differential to variation in land use are unclear at this stage of research.

- 226 NORRIS, AMY R. AND COURTNEY T. HACKNEY. Dept. of Biological Sciences, University of North Carolina, Wilmington, NC 28403-Silica content of intertidal marshes in the Cape Fear River Estuary, North Carolina.

Studies of silicon cycling in estuarine systems have primarily focused on terrestrial inputs, benthic fluxes, and uptake and recycling of silica (SiO_2) by diatoms. However, intertidal marsh vegetation, which often covers a large area and contributes a high biomass to estuarine systems, also contains silica. The silica content of *Juncus roemerianus* and *Spartina alterniflora*, two dominant species in east coast estuaries, was used to obtain an estimate of silica contained in intertidal marshes in the Cape Fear River Estuary, North Carolina. This estuary has 8900 ha of intertidal marshes which contain approximately 7.4×10^9 g SiO_2 in sediments, of which only 4.44×10^7 g is bioavailable in the form of dissolved silicic acid (H_4SiO_4), and 0.62×10^9 g SiO_2 in plants. The two species have a similar silica content (approximately 0.60 % per dry biomass) and tend to accumulate silica with age. These data indicate that intertidal vegetated habitats may be an important reservoir of silica in estuaries.

- 227 EGLESTON, D. DUBOSE. Department of Biology, Furman University, Greenville, SC 29613 - Management of a limited-entry fishery: Predictions on fall channel net shrimp catches in Winyah Bay, South Carolina.

A specialized shrimp fishery has evolved in the last century in South Carolina that is different from any other on the coast of the United States. Channel netters have had access to the state's white shrimp (*Penaeus setiferus*) resource in Winyah Bay since the early 1970's. As a relatively unspoiled bay, this area is highly prized for its natural resource and must be intensely managed. This study examines a method of managing the fishing season in the bay and the effectiveness of sampling efforts in predicting the best times to open the season. Recent and historical sampling efforts in Winyah Bay were compared to commercial landings to determine their correlation. It was found that samples were very effective at determining sizes in later commercial catches ($r^2 = 0.637$, d.f. = 11). However, the sampling was not as effective in determining overall catches ($r^2 = 0.335$, d.f. = 11). Possible explanations of this are explored.

- 228 CRUZAN, MITCHELL B. Department of Ecology and Evolutionary Biology and Department of Botany, University of Tennessee, Knoxville. - Workshop - Floral Biology.

Studies of plant reproductive biology have made significant contributions to our understanding of ecological and evolutionary processes in plant populations. In particular, the biology of pollen and pollen-pistil interactions can play a large role in determining mating patterns in plants. While observing and quantifying aspects of pollen biology is often technically difficult and tedious, recent advances in the use of genetic markers and computer-aided video image analysis can facilitate the acquisition of information on plant reproductive processes. In this workshop we will explore several techniques for the analysis of plant reproduction including methods for quantifying pollen germination and pollen-tube growth, the use of genetic markers and pollen mixtures to infer pollen competition and fertilization ability, and the use of image analysis to acquire data on pollination and pollen growth. Discussions and demonstrations will include the design and analysis of genetic marker experiments and uses and limitations of computer imaging technology.

- 229 ALKAFF, HUDA F. Science Education Department and Institute of Ecology, The University of Georgia, Athens, GA 30602 - An exploratory study of students' perceptions of environmental literacy in higher education

The major objectives of this study were to determine the effectiveness of quarter-long environmental literacy courses in improving environmental literacy among undergraduate students in the cognitive and affective domains and to determine if any changes induced in the participants were enduring. The

Environmental Literacy Criteria Instrument was administered in three different environmental literacy classes to volunteer subjects, on the first and last days of the quarter and eight months after the end of the courses. The results were analyzed using t-test and multivariate analyses. According to the author's environmental literacy assessment criteria, a significant positive change in the students' learning outcomes resulted from taking one of the three environmental literacy courses investigated in this study. This positive change was sustained to a significant degree after a delayed period of time.

- 230 KNAUPER, BEVERLY A. Dept. Biology, Raymond Walters College, University of Cincinnati, Cincinnati, OH 45236 - The Use of Primary Trait Scoring as an Assessment Tool.

Primary Trait Scoring is a course-embedded assessment technique that can be used to assess student learning in individual course assignments, for academic programs, and at the institutional level. Primary trait scoring makes explicit the criteria for grading and assessing student work. The instructor first identifies those factors or "traits" that are important and then builds a performance scale for those traits. A lab report written for an introductory biology course is utilized as an example that can be scored for a course grade, for specific skills in a technical program, and for student critical thinking skills for college-wide assessment. As added benefits, students receive the scoring criteria to guide them in their assignment and primary trait scales make grading more consistent and faster.

- 231 JONES, JODY. Jacksonville State University - Alabama Science in Motion: Making the connection.

Jacksonville State University's Science in Motion program provides area secondary students with laboratory experiences in molecular biology, physiology, ecology and bacteriology. Funded by the State Department of Education and jointly supported by the Teacher In-Service Center and the Department of Biology, this program is available to teachers within a seven county area. Selected teachers work with faculty in extensive training sessions to develop activities coordinated with the Alabama Science Course of Study. Jacksonville State University's Science in Motion project is one of 22 such programs established across the state. Each helps to ensure a quality science education for Alabama's students and forms a vital link between the science classroom and higher education.

- 232 SWAB, JANICE C. Department of Biology and Health Sciences, Meredith College, Raleigh, NC 27606 - "Science and Religion" courses as opportunities for consideration of controversial topics.

Courses in "Science and Religion," usually team-taught, present opportunities for students to examine issues that are considered to be controversial. A course at Meredith, "Issues in Science and Religion," is team-taught by two faculty members from the Departments of Biology and Health Sciences and Religion and Philosophy. The course description reads: "The course will explain the real and alleged conflicts between science and religion from an historical and methodological perspective. Controversial figures and issues will be examined, including Galileo, Kepler, Newton, and Darwin. The differing methods of science and religion for discovering truth and evaluating truth claims will be discussed. How science and religion can pursue common environmental goals will be a major topic." As biology teachers in the southeastern U.S., we know that we have a special obligation to help students understand the central place that evolution has in our discipline. We lament the lack of, or scant, useful information in textbooks that our students read. We struggle to find ways to lead students to understand the history and current status of ideas in this area. Perhaps courses of this type are one way of doing this.

- 233 COOK, REBECCA A.¹ AND KENNETH D. McFARLAND.² ¹Biology Department, Monmouth College, Monmouth, IL 61462 and ²Botany Department, University of Tennessee, Knoxville, TN 37996-1100 - Use of modeling clay to illustrate plant structures and developmental processes.

The challenge of motivating students to learn the details of life cycles and developmental processes has been the bane of biology teachers for generations. In restructuring the Introductory Botany course at the University of Tennessee, Knoxville, we have incorporated the use of clay into the laboratory. Requiring the students to make three-dimensional models of structures gives them a more active role in the learning process. We have found this modeling technique to be useful in illustrating the structural details of strobili

and flowers. Additionally, this technique helps illustrate and explain the evolution of spores, sporangia, and sporophylls into seeds and fruits. These applications and others will be illustrated.

- 234 ALIFF, JOHN VINCENT. DeKalb College - Gwinnett, 5155 Sugarloaf Pkwy., Lawrenceville, GA 30243 - Study Guides and Notes for Anatomy and Physiology: Guidelines for Preparation, and Use by First-year Students.

"Study Guides and Notes for Anatomy and Physiology" simplify learning objectives, reduce the intimidation of a one thousand page textbook, and allow students to spend more time listening to lectures rather than writing copious, detailed notes. Based upon the old Barnes and Noble "College Outline" Series of diagrams to be labeled by students, questions are inserted within the text as well as at the end of chapters, and active learning exercises are also incorporated. Benefits to the instructor include: less time is spent at the board writing notes or drawing and proportionally more time can be used for overhead projection, laser disk projection and computerized multimedia presentation; producing these gives us opportunity to update those "old notes" every year or at each change of textbook.

- 235 PITTMAN, ALBERT B., KATHERINE A. BOYLE, ANN R. DARR, FRANCOIS SMITH, and CYNTHIA A. SMITH. South Carolina Department of Natural Resources - Vegetation of sandhill streamhead pocosins at Fort Jackson, South Carolina.

Dispersed throughout the Fall Line Sandhills of South Carolina are numerous springs and seeps that give rise to a distinctive assemblage of plants and animals -- some of which are very narrowly distributed endemics. Historically, the sandhill belt has escaped row crop agriculture and urban development and remains the largest expanse of longleaf pine in the region. However, increasing demands for water, inexpensive land for low income housing, type conversion to loblolly pine monoculture, and recreational pond construction increasingly threaten this important ecosystem. The headwaters of these sandhill streams are typically acidic, organically rich, nutrient poor, low in turbidity, and rated "A" in water quality. They are dominated by a unique combination of bottomland hardwood and broadleaf sclerophyllous shrub species known as pocosins. In sharp contrast are the profoundly xeric conditions of the uplands composed of very coarse sands supporting large tracts of longleaf pine/turkey oak communities. In addition, there are unique artesian spring systems which provide habitat to a number of very restricted plant and animal species some of which have been listed as species of concern, threatened, or endangered under the US Endangered Species Act. Recent taxonomic study of collections of Noturus (Phylum: Chordata) and Lobelia (Phylum: Anthophyta) confirm that a new species of broadtail madtom and lobelia have been collected from these systems. Because of the sharply contrasting vegetation structure and soils of the uplands versus the streamside pocosins, high resolution near-infrared photography was used to screen for the most favorable sites. Spatial data was analyzed in Arc Info, mapped with Atlas GIS, geo-positioned with the Trimble Navigation System and compiled in the SC Heritage Program \ The Nature Conservancy's Biological Conservation Database.

- 236 PITTMAN, ALBERT B. South Carolina Department of Natural Resources -- A new species of Lobelia (Campanulaceae) from the Carolina Sandhills.

A new *Lobelia* has been discovered in the streamhead pocosins of the Carolina sandhill belt. Cytological, morphological, herbarium, garden, and field studies provide evidence that this is a new species of the medium-sized, blue flowered lobelias and is apparently endemic to the Inner Coastal Plain of South and North Carolina. This new taxon is to be named in honor of Wade T. Batson, a longtime student of the flora of the Carolinas.

- 237 ALLISON, JAMES R. Georgia Dept. of Natural Resources, Natural Heritage Program - Rediscovery of the whorled sunflower, *Helianthus verticillatus* Small.

In 1898 J. K. Small described a new species of sunflower, *Helianthus verticillatus* (Bull. Torr. Bot. Club 25:479), based on an 1892 collection of L. M. Bain from "wet, sandy soil" near Henderson, Chester County, Tennessee. Besides its mostly whorled leaves, Small distinguished it from the related *H. giganteus* by its "smooth and glabrous stem, the narrower entire smooth leaf-blades and the narrowly linear-lanceolate bracts of the involucre." Beatley (J. Tenn. Acad. Sci. 38:153, 1963) speculated that the whorled phyllotaxy in the single known collection resulted from hybridization between opposite- and alternate-leaved parental species. In the fall of 1994 I determined as *H. verticillatus* a collection made that September by Richard Ware, an amateur botanist from Rome, Georgia. This first collection of the species in more than a century came from a remarkable prairie site I had discovered in 1993 in Floyd County, Georgia, but had never visited in the fall. The plant occurs in Georgia in two populations less than 0.3 km (0.2 mi.) apart, one large (>1000 stems), the other quite small (<20 stems). The site of the larger population is probably the most significant locality for

biodiversity in Georgia, for it also supports populations of at least nine other rarities, including nationally Threatened *Marshallia mohrii*. In October, 1996, accompanied by Alfred Schotz, I discovered a population of several hundred stems of *H. verticillatus* in Cherokee County, Alabama. This site is about 3.2 km/ 2 mi. from the Georgia populations, and like them, more than 320 km/200 mi. from the type locality.

- 238 HOUSER, CRYSTAL C.¹, JAMES F. MATTHEWS¹, AND CHRISTOPHER R. MATTHEWS².
¹Dept. Biological Sciences, Univ. of North Carolina, Charlotte. NC 28223 and ²HDR Engineering, Charlotte, NC 28202 - *Helianthus verticillatus* rediscovered

In 1898, Small described a new species of sunflower, *Helianthus verticillatus*, based on specimens collected by Bain in western Tennessee in 1892. Three herbarium specimens exist, two in NY and one at US. This species has never been seen in the wild and is generally not included in most treatments of the sunflowers. Brief discussions of the species have alluded to its potential hybrid origin. The finding of a population of a whorled-leaved sunflower in west Georgia has allowed comparisons of the morphology of live plants with Small's original description. Bain's specimens had five leaves per node but the entire plant was not present. The natural population shows greater variation in leaf arrangement, number of leaves per node, glaucousness and pubescence of the stem. His specimens also lacked roots; however, this taxon has tuberous enlargements and elongate rhizomes. Root tip squashes reveal a chromosome number of $2n=34$, making this a diploid member of the genus. A preliminary isozyme analysis, employing ten enzyme systems and four other species of *Helianthus* considered to be possible parents, showed only frequency differences and no fixed differences in enzymes. These preliminary results indicate that this newly discovered taxon may indeed be *Helianthus verticillatus* Small.

- 239 NOEL, WILLIAM, L.L. GADDY AND JOHN E. FAIREY, III. Clemson University -
Floristic study of the Tallulah Gorge.

The Tallulah Gorge has long been known for harboring a unique flora. Located in Habersham and Rabun Counties, Georgia, the Tallulah River has formed a 300 meter deep gorge through later Precambrian quartzite and graywacke/schist. Since March, 1996, several hundred voucher specimens have been collected. This study will add to the floristic knowledge of similar gorges in North Carolina, South Carolina, and Georgia. The gorge has been devoid of natural river flow since the turn of the century due to hydroelectric power generation. Six habitat types have been identified throughout the gorge, consisting of xeric pine habitat, xeric hardwoods, midslope mixed mesophytic hardwoods, cove hardwoods, seepage slope, and riverine. *Trillium persiciens*, a South Carolina and Georgia endemic, is prevalent throughout the mixed mesophytic hardwood, cove hardwood, and riverine environments. Northern species such as *Deschampsia flexuosa* and *Carex albusina* are common near the bottom of the gorge. Species rare to the Southern Appalachians found in the gorge include *Plantanthera integrilabia*, *Carex amplisquama*, and *Carex pedunculata*. *Parnassia asarifolia* abounds in many of the streams and seeps along with several populations of *Drosera rotundifolia*. A historic population of *Xerophyllum asphodeloides* was relocated near the rim, as well as several small populations of *Tsuga caroliniana*.

- 240 STALTER, RICHARD. St. John's University Jamaica, NY - The vascular flora of Sagamore Hill National Historic Site, Long Island, New York

The vascular flora of Sagamore Hill National Historic Site, Long Island, New York consists of 205 species within 162 genera and 71 families. The historic site, comprising 33 hectares, was part of a larger property of 63 hectares purchased by Theodore Roosevelt in 1883 for the sum of 30,000 dollars. The former president's home site was purchased by the Theodore Roosevelt Association in 1950, and in 1963 the Association presented the site to the American people as a gift. The National Park Service acquired the property in 1963 and opened the area to the public in 1963. The habitats at Sagamore Hill include woodland, an old orchard remnant, mowed fields, lawns and gardens. Most of the taxa at Sagamore Hill are found in ruderal disturbed sites including roadsides, lawns and maintained gardens. Sixty nine species, 34 percent of the flora, are not native to the United States; most of the non-native plants are found on disturbed sites.

- 241 SECKINGER, GEORGE W., Jr. AND JOHN B. NELSON. Dept. of Biological Sciences, A. C. Moore Herbarium, University of South Carolina, Columbia SC 29208 - Vascular plant survey of the Prince George Tract, Georgetown County, South Carolina.

A floristic inventory of the Prince George Tract was begun in May 1995. The study site, comprising 770 ha (1900 ac), occurs as an east-west trending parcel of land between the Waccamaw River and the Atlantic Ocean, situated between the Belle W. Baruch Marine Research Center and Pawleys Island in Georgetown County, South Carolina. This site features typical outer coastal plain topography, and includes a range of marine, terrestrial, estuarine, palustrine, and riverine environments. In addition, non-natural habitats (impoundments, old rice fields, borrow pits, disturbed ground) are present as well. Historically, the area is known for timber cutting and turpentine operations, and prior to that, extensive rice cultivation. Of particular interest are fresh water swamps situated in old dune swales, and fresh-water marshes along the Waccamaw River, both of which feature relatively high species composition. To date, after the first full growing season of study, 77 vascular plant families, 134 genera, and 214 species are reported. The initial portion of this study suggests that species number at the site will be comparable to those recorded at nearby and similar areas including the Baruch Center, and the Tom Yawkey Wildlife Center, both to the south. Portions of the Prince George Tract, which was acquired by the University of South Carolina Development Foundation, will be developed as a research facility and environmental education center.

- 242 HILL, STEVEN R. Illinois Natural History Survey - The prairie element in the flora of Oconee County, South Carolina.

The flora of Oconee County, in the mountain region of northwestern South Carolina has been extensively surveyed. More than 1020 taxa of vascular plants have been found in the county to date. While prairie remnants in South Carolina have been found and studied primarily in York and surrounding piedmont counties, a number of essentially prairie species still occur in drier open areas of Oconee County and other parts of the upstate. Some are uncommon and most are not generally recognized as prairie elements. Over 50 species listed for Oconee County are also commonly found in the existing prairie communities of Illinois, for example, and may be viewed as survivors of a time when prairies were more extensive in South Carolina. Some examples of these include *Eryngium yuccifolium*, *Asclepias amplexicaulis*, *Coreopsis tripteris*, *Echinacea laevigata* (a counterpart to the prairie *E. pallida*), *Heliopsis helianthoides*, *Parthenium integrifolium*, *Silphium* spp., *Lespedeza hirta*, *Psoralea psoralioides*, *Tephrosia virginiana*, *Sisyrinchium albidum*, *Andropogon gerardi*, *Schizachyrium scoparium*, *Sorghastrum nutans*, *Ceanothus americanus*, *Rosa carolina*, *Comandra umbellata*, and *Veronicastrum virginicum*.

- 243 EVANS, DAN K. Herbarium, Marshall University - Botany and brujos: traditional healing with plants and magic among the indigenous Shuar and Achuar people of southeastern Ecuador.

Indigenous Shuar and Achuar occupy a large part of southeastern Ecuador. Modern medicine is well established in the area and is supplemented by a variety of traditional plant medicines. Brujos practice traditional healing by invoking the spirit world while under the influence of hallucinogens from plant sources. Sources of psychoactive drugs from the Malpighiaceae are *Banisteriopsis caapi* (stems) and *Diplopterys cabrerana* (leaves). Additional sources of hallucinogens are harvested from members of the Solanaceae including *Brugmansia suaveolens* (stem bark), *Nicotiana tabacum* (green and cured leaves) and *Brunfelsia* sp. (leaves and stem bark). All taxa are commonly cultivated near traditional houses. Just prior to a healing session observed in 1996, stems of *Banisteriopsis* were washed and crushed with rocks and combined with leaves of *Diplopterys* in a pot of approximately 15 liters of water. During seven hours of slow boiling the liquid was reduced to a thick, brown and sticky residue. Approximately 100 ml of warm water were added to the residue. At the same time, green tobacco leaves were crushed in water producing about 50 ml of thick, green liquid. Additionally, green tobacco leaves were quick-cured over an open fire and fashioned into large newspaper-wrapped cigars. At the beginning of the healing session the brujo drank the malpighiaceae mixture, aspirated the tobacco liquid from the palm of his hand and profusely inhaled smoke from the cigars. Under the influence of these materials he commenced the healing session involving an elderly woman suffering from partial blindness. Details of the healing session will be described.

- 244 ROHDE, FRED C., JOSEPH M. QUATTRO, AND RUDOLF G. ARNDT. North Carolina Division of Marine Fisheries, University of South Carolina, and the Richard Stockton College of New Jersey - To be or not to be: the case of *Etheostoma saluda*.

Etheostoma saluda, subgenus *Hololepis*, was described by Hubbs and Cannon in 1935 from tributaries of the Saluda River in South Carolina. At the same time they described *E. collis* from several streams in the Catawba River drainage, also in South Carolina. Subsequently, *E. collis* has been found scattered throughout the Piedmont of North Carolina and into Virginia. Two characters were held to separate the two species: interorbital pores almost always 0 in *collis* vs. 2 in *saluda*; and anal spines always 1 vs. usually 2. Jenkins and Birkhead (1993) regarded the two species to be conspecific since they felt that the variation was mosaic with no nominal taxon or drainage population to be sufficiently distinctive to warrant taxonomic recognition. We examined *E. collis-saluda* from throughout its range and compared the populations using meristic characters and mitochondrial DNA gene sequence analysis. Results will be discussed and a phylogeny of the subgenus *Hololepis* will be presented.

- 245 STOLL, SYAM¹, PATRICK ANDERSON¹, MICHAEL LITTLE¹, AND JOHN WILEY².
¹Dept. of Biological Sciences, Marshall University, Huntington, WV and ²East Carolina University School of Medicine, Greenville, NC - Ribosomal gene and telomere locations in the cyprinid fishes, *Rhinichthys cataractae* and *Nocomis micropogon*.

The cyprinid *Rhinichthys bowersi* is a rare fish mostly restricted to headwater tributaries of the Cheat River, West Virginia. This fish has been variously described as a species or a *Nocomis micropogon* X *R. cataractae* hybrid. Recently investigators have used ribosomal DNA (rDNA) and interstitial telomere polymorphism to determine phylogenetic relationships among vertebrates. In this study, we located rDNA and interstitial telomeric DNA on chromosomes of *N. micropogon* and *R. cataractae* to determine whether these genetic markers might be used to resolve the taxonomic status of *R. bowersi*. Ribosomal DNA genes differed in number and location between the two species. If *R. bowersi* is a hybrid, then its chromosomes should contain rDNA polymorphisms of both parental species. Interstitial telomeres were present in both species but not consistently paired on sister chromatids and not considered phylogenetically useful.

- 246 MCGUIRE, WILLIAM R., EUGENE G. MAURAKIS, AND WILLIAM S. WOOLCOTT. St. Christopher's School, Science Museum of Virginia, University of Richmond - Cephalic skin morphology of tuberculate male *Semotilus atromaculatus*.

Morphology of cephalic skins of tuberculate male *Semotilus atromaculatus* (Cyprinidae) were studied to test the hypothesis that neurons underlie tubercles. Light microscopy reveals that dermal pilli which protrude into cephalic tubercles of breeding males contain neurons. Scanning electron micrographs indicate that neural projections in the form of neuromasts may be related to the developmental patterns of tubercle distribution in the species. Identification of neural-tubercle connections supports previous hypotheses that male epidermal tubercles play a tactile role in breeding behaviors of *S. atromaculatus* during the spring.

- 247 MENHINICK, EDWARD F. Dept. Biology, University of North Carolina at Charlotte - Heavy metal uptake by clams and fishes.

Uptake of heavy metals and other elements was studied in ten streams (tributary to Rocky River east of Charlotte, NC) which had drainage areas of approximately 50 square miles each. Samples of water, clams and five species of fishes were run using 32 element ICP analysis by the Environmental Laboratory of the University of Georgia. The streams differed in substrate, drainage use, low flow rate, and two had waste water treatment

plants upstream. Species examined included Asiatic clams, tessellated darters, redlip shiners, margined madtoms, bluehead chubs, and redbreast sunfishes. Fishes had much higher amounts of calcium, strontium, potassium, phosphorus, selenium, uranium, and gold than did clams. Clams, in turn, concentrated boron, cadmium, cobalt, copper, iron, and nickel in much higher amounts than did fishes. Darters in this gold-rich area of the state contained about 8 ppm gold; shiners had 50 ppm uranium; and sunfish and chubs had 3 ppm arsenic. Clams from streams with unusually high levels of molybdenum contained about twice normal values of it and are potential indicators of this pollutant.

248 PILLER, KYLE R.^{1,2}, DAVID J. EISENHOUR¹, and BROOKS M. BURR¹. ¹Dept. of Zoology, Southern Illinois University at Carbondale, Carbondale, IL 62901 and ²Tulane Museum of Natural History, Belle Chasse, LA 70037 - Status survey of the sturgeon chub, *Macrhybopsis gelida*, and the sicklefin chub, *M. meeki*, in the middle Mississippi River, Illinois.

The sturgeon chub, *Macrhybopsis gelida*, and the sicklefin chub, *Macrhybopsis meeki*, are two cyprinids that inhabit the main channels of large turbid rivers in the Midwest. They are known only from the Missouri River and the lower reaches of a few major tributaries and from the lower Mississippi River. We attempted to determine the present distribution and status of both species in the section of the Mississippi River bordering Illinois. The study began in the Fall of 1995 and continued through the Summer of 1996. Eighteen historical collections of *M. gelida* and 37 historical collections of *M. meeki* were located from the Mississippi River. Examination of these collections indicate that both species have declined in distribution and abundance since the early 1960's. These species were absent in all eighteen collections made during this survey. An additional 15 sites were reconnoitered that lacked suitable habitat. The middle Mississippi River has been extremely modified for navigation and flood control and is presently almost entirely void of critical habitat for these species. Although neither species was found in this survey, several recently collected specimens (1994-1995) indicate that both species are likely extant, although extremely rare in Illinois.

249 BART, HENRY L., JR. AND ROYAL D. SUTTKUS. Tulane Museum of Natural History, Belle Chasse, LA 70037 - Conservation status of the Pearl darter, *Percina aurora*.

The Pearl darter *Percina aurora*, a recently described percid species known only from the Pearl and Pascagoula river drainages (LA, MS), is in danger of extinction. Pearl darters have not been collected in the Pearl River since 1973, despite the fact that two reaches of the river that historically supported pearl darters have been surveyed quarterly from that time to the present. The species still survives in the Pascagoula River drainage, but is extremely rare. Analysis of long term survey data from the Pearl River drainage (1963-present) reveals that the species was rare before its disappearance (occurring in 48 of 118 collections and representing only 0.15% of total catch). Variation in *P. aurora* abundance was not correlated with variation in other gravel riffle inhabiting darters. Number of *P. aurora* in collections correlated only with total number of fish collected and amount of time spent collecting. We could detect no trend of increase or decrease in abundance leading up to the time the pearl darter was no longer collected, nor could we detect trends. If extinction of the pearl darter from the Pearl River was a consequence of low population size, then the population in the Pascagoula River is vulnerable to a similar fate.

250 JONES, DALE B., JOSH O. HARPER, AND GENE S. HELFMAN. Institute of Ecology, University of Georgia, Athens, GA 30602 - The effects of land use on fish assemblages and stream habitats in the Little Tennessee River drainage.

We are studying the effects of land use on fish assemblages in the southern Appalachians. As part of this work, we examined the effects of non-forested patch size on fish assemblages and stream habitats in the Little Tennessee River drainage. We chose 12 sites in catchments of similar size along a gradient of different size non-forested patches. All non-forested patches were directly upstream of our sampling sites. We found that patch size does have an effect on both fish assemblages and available habitat. Fish assemblages changed in numbers and composition as patch size increased. The density of fish decreased as non-forested patch size increased. Likewise, the number of riffle dwelling species (percids and cottids) also decreased as patch size increased. The number of centrarchids, catostomids, and cyprinids increased as the size of the non-forested patch increased. Several mesohabitat categories were developed based on velocity and depth combinations. Shallow pool habitat (depth <= 20 cm and velocity <= 0.2 m/sec) decreased, while moderate (depth = 21-50 cm and velocity <= 0.2 m/sec) and deep pool (depth > 50 cm and velocity <= 0.2 m/sec) habitats increased as patch size increased. The riffle and run habitats showed no significant relationships with non-forest patch size. The amount of fine sediments in riffle habitats increased as patch size increased. These findings suggest

that available pool habitats may play a role in increasing the abundance of pool dwelling species (centrarchids, catostomids, and cyprinids) for the large non-forested patches. Available riffle habitats did not change with respect to patch size, therefore reductions in riffle dwelling species (cottids and percids) are not due to the lack of available riffle habitats but might be due to the quality of the available riffle habitats. These habitats are easily degraded through processes such as sedimentation.

- 251 PETTY, J. TODD AND GARY D. GROSSMAN. School of Forest Resources, University of Georgia, Athens, GA 30602 - Patch selection by mottled sculpin, *Cottus bairdi*, in a southern Appalachian stream.

We examined the effects of small scale variation in physical habitat and prey abundance on patch selection by a predatory benthic fish, the mottled sculpin, in a southern Appalachian stream. Patches were characterized in terms of physical habitat variables and invertebrate abundance. We quantified patch selection by comparing the characteristics of patches utilized by sculpin with those of locally available patches. We also examined the relationship between invertebrate abundance and the physical characteristics of available patches. Patches selected by sculpin contained significantly higher invertebrate abundances than locally available patches in five out of six seasonal samples. Patches utilized by sculpin, however, could not be consistently differentiated from locally available patches on the basis of physical variables. In addition, invertebrate abundance was not consistently related to physical habitat variables during the course of the study. Our results suggest that sculpin are able to assess patch quality on the basis of prey abundance rather than physical cues and select patches that potentially maximize energy gain. This behavior may produce an increase in individual fitness, especially when prey abundance is not consistently related to physical habitat variables. Quantifying patch use in relation to prey abundance may help elucidate the causal factors determining habitat use by benthic fishes in other lotic systems.

- 252 NEELY, DAVID A. Dept. of Biological Sciences, University of Alabama, Tuscaloosa, AL 35487 - A contact zone between two allopatric forms of the mottled sculpin, *Cottus bairdi*: a test of species boundaries within the complex.

Stream capture between the Ohio River Basin and Atlantic Slope drainages has been hypothesized in several capture arenas. Contact between two morphologically discrete forms of the mottled sculpin, *Cottus bairdi*, was observed in Wills Creek, Somerset Co., PA. The nature of the contact zone seems to provide some evidence of reproductive isolation between the two forms. Sheared PCA of morphometric and meristic data was used to identify patterns of differentiation between the two forms. These data are corroborated by a reanalysis of a prior study of morphological and genetic differentiation within Eastern *Cottus*.

- 253 ROGERS, JASON. University of North Carolina at Wilmington - Age and growth of pelagic larvae and juveniles of the reef fish *Monacanthus hispidus*.

Approximately two hundred otoliths of the planehead filefish, *Monacanthus hispidus*, are being examined to aid in illuminating early life history patterns. Through light microscopy, otolith microstructure is being analyzed to answer the following questions. What is the general growth rate for the species, as well as a size at age distribution? Does the species form a check when association with *Sargassum* occurs? If so, then at what size and age does this association occur? Due to the species negatively buoyant eggs what is the size distribution throughout the water column? In conjunction with these questions about microstructure, a sub-sample of otoliths read under light microscopy will be prepared for scanning electron microscope examination. Through this procedure the reader's accuracy in enumeration of increments will be tested. Since there has been little work done on this species, daily increment formation will need to be validated. *M. hispidus* will be collected in Onslow Bay, North Carolina and immersed in oxytetracycline. These fish will then be raised in a flow-through mesocosm to aid in eliminating laboratory biases.

- 254 HANEY, DENNIS C.¹, STEPHEN J. WALSH², FRANK G. NORDLIE³, TINA L. YANCHIS⁴, and CINDY M. TIMMERMAN³. ¹Department of Biology, Furman University, Greenville, SC 29613, ²National Biological Service, Gainesville, FL 32608, ³Department of Zoology, University of Florida, Gainesville, FL 32611, and, ⁴Division of Fishes, Florida Museum of Natural History Gainesville, FL 32611 - The influence of salinity on osmoregulation and temperature tolerance in the sheepshead minnow, *Cyprinodon variegatus*.

Cyprinodon variegatus inhabits coastal environments of the western Atlantic ocean and Gulf of Mexico. Typically this species is found in waters of widely varying salinity (0 to 142 ppt) and temperature (1°C to >

41°C). This study examined: (1) the osmoregulatory ability of individual *C. variegatus* exposed to cyclical salinity regimes, and (2) the influence of different salinity-temperature combinations on the temperature tolerance of individual fishes. Plasma osmolality was effectively regulated by *C. variegatus*, even when fishes were exposed to large fluctuations in salinity (20-30 ppt). However, fishes previously exposed to large salinity fluctuations did regulate plasma osmolality more precisely than fishes that previously experienced small or no changes in salinity. Temperature tolerance ranged from 40.4°C (0 ppt, 25°C acclimation) to 44.4°C (17.5 ppt, 35°C acclimation). Salinity had little effect on temperature tolerance except in fishes acclimated to 0 ppt, where tolerance was significantly less than at all other salinities tested.

- 255 POWELL, ALLYN¹, ²DAVID LINDQUIST, and ¹J ON HARE. NOAA, National Marine Fisheries Service, Beaufort, North Carolina 28516¹ and Dept. Biol. Sci. & Center for Marine Science Research, University of North Carolina at Wilmington, 28403² - Larval and pelagic juvenile fishes collected with three types of gear in Gulf Stream and shelf waters off North Carolina.

Three complementary ichthyoplankton samplers were used to collect a complete series of pelagic larvae and early juveniles along a transect from open-shelf to Gulf Stream waters off North Carolina in September, 1994. Sampling gear included a 60 cm bongo sampler (.333 mm mesh), 1x2 m neuston net (.947 mm mesh) and a 5m² Methot frame trawl (3x4 mm oval mesh). Targeted were reef fish taxa that are associated with small areas of rock outcroppings on the open-shelf. The bongo sampler was effective in collecting larvae <10.0 mm while the neuston net and frame trawl were effective in collecting larger larvae, although at lower densities. With the exception of the surgeonfishes (Acanthuridae), the frame trawl was not effective in collecting larger reef fish taxa. A wide range of larval sizes of *Selar crumenophthalmus*, *Antigonia* sp., *Bothus* spp., and *Nesiarichthys nasutus* were collected with the bongo and frame trawl. The neuston net effectively sampled pelagic juvenile *Coryphaena equisetis* and *C. hippurus*, but not similarly sized scombrids. The hydrography of the study area changed within the 48-hour sampling period and appeared to influence the distribution of ichthyoplankton at least on the outer-shelf (60-183 m deep). These findings indicate that larval distributions are influenced by relatively short time scale processes and suggest that spurious conclusions can be reached if the dynamic nature of the physical environment is not considered.

- 256 SCHWARTZ, F. J. AND J. HURST, Institute Marine Sciences, UNC - My, what big teeth you have - Ma.

Upper and lower jaw tooth surface areas and positions were highly correlated in newborn male and adult male and female Atlantic sharpnose sharks, *Rhizoprionodon terraenovae*. Newborn male tooth areas and positions were shallower and wider than in adult males. Upper jaw tooth areas were larger than lower jaw teeth areas, in both sexes. Female tooth jaw surface areas were larger, in both jaws, than in males. Males possessed a cross bite and were wider at the symphyses of the jaws, perhaps aiding them when feeding or holding a female during mating. Smaller surface area lower jaw teeth of both sexes facilitated penetration when feeding. Feeding behavior may be correlated to jaw morphology, jaw tooth surface area, and tooth position in the jaw.

- 257 MILLER, SUSAN P. University of Georgia Savannah River Ecology Lab, Aiken SC - Nutrient limitations in dystrophic systems: do dominant Carolina bay grasses have inherently low growth rates?

Dystrophic wetland systems such as Carolina bays are characterized by high levels of DOC and dilute nutrient pools. This study addressed two questions: 1) what are the main nutrient limitations to plants in Carolina bay soils?, and 2) do the dominant grasses in these systems have inherently low relative growth rates (RGRs)? I experimentally compared the growth of the dominant grasses *Panicum hemitomon* and *Leersia hexandra* to *Oryza sativa* (rice) on Carolina bay soils that were amended with nitrogen (N), phosphorus (P), both nutrients (P&N), and on control (unamended) soils. Using successive bi-weekly harvests, I measured numerous parameters including biomass partitioning, relative growth rate (RGR), leaf area rate of increase, and shoot nutrient content. Growth rates on control (*Leersia*: 11.48, *Panicum*: 15.00, *Oryza*: 26.43) and N-amended (3.88, 18.11, 17.33, as above) soil were very low, with the *Leersia* RGR being significantly lower in both treatments (p<0.05). All three species showed higher RGRs on the P-amended soil (40.4, 39.1, and 44.3; no significant differences) than on the control, and highest RGR on the N and P-amended soil (205.1, 178.9, 415.4; *Oryza* significantly higher). These data suggest that P is the primary limiting nutrient in these soils, with N-limitation being secondary. All species showed a similar response to P addition, but the native grasses did not exhibit as high a growth response as *Oryza* under combined P&N conditions.

- 258 CORBIN, JEFFREY D. University of North Carolina at Chapel Hill - The effects of three years of nitrogen and phosphorous addition on a deciduous forest understory community and soil nitrogen availability.

Ecosystems in the eastern United States currently receive elevated inputs of nitrogen (N) from atmospheric deposition. Consequently, it is critical that we understand how the resultant changes in nutrient availability affect terrestrial plant communities and soil resources. In 1994 I established a series of 10m X 10m plots in a randomized block design and assigned each plot to one of the following treatments: +N; +P (phosphorous); +N+P; and control which received no supplemental nutrients. Treatment applications were performed once per month during the growing season from 1994-1996. Very small quantities of nitrate (NO_3^-) were found in the soil and in lysimeter groundwater samples in any of the plots, indicating that none of the treatments have saturated the ecosystem's ability to assimilate added N. Net mineralization of N into ammonium (NH_4^+), a measure of soil N availability, increased in +N and +N+P plots as compared to +P and control plots. I measured changes in the number of stems per m^2 and the above-ground biomass of each species in each treatment using ANOVA. I also characterized the plant community using Canonical Correspondence Analysis (CCA). Neither N nor P addition dramatically changed the community composition relative to controls, though biomass and tissue N concentrations indicated that not all species responded to the nutrient additions equally. Differences in species' responses to N and P addition may be important factors in determining the direction of future community change.

- 259 LEVI, JEFF A. and WILLIAM J. PEGG. Frostburg State University- Nodulation of *Trifolium pratense* in fluidized bed ash amended strip mine reclamation soil: *in vitro*.

Strip mine reclamation soils require amendments of fertilizers and buffers to increase the success of revegetation efforts. Fluidized bed ash (FBA) is characterized by a high pH resulting from the addition of CaCO_3 during the combustion process. This alkalinity provides a basis for neutralizing acidic strip mine soils found in western Maryland. Seeds of *Trifolium pratense* were surface sterilized and germinated in varying mixtures of strip mine reclamation soil (SMRS) and fluidized bed ash (FBA). Each mixture was inoculated with commercial symbiotic *Rhizobium*. The following amendment ratio (wt/wt) was used: 0 to 20% (wt/wt) FBA/SMRS at 3% increments. Each sample was exposed to controlled conditions including a 12 hr. photoperiod, and daily temperatures averaging 23°C. After 10 weeks of growth seedlings had reached the trifoliate stage and 75% were harvested. The number of nodules per seedling was recorded, and the mean per treatment was calculated and analyzed with ANOVA and linear regression. After 16 weeks the remaining seedlings were analyzed for nitrogenase activity using an acetylene reduction (AR) assay. Application levels below 15% offer the best combination of nodule production, and buffering capacity of acidic soils. AR assay showed no activity, possibly due to sufficient nitrate concentrations already present in the soil.

- 260 MCCARRON, JAMES K.¹, KENNETH W. MCLEOD¹ AND WILLIAM H. CONNER². ¹Savannah River Ecology Laboratory, Aiken, SC 29802 and ²Baruch Forest Science Institute, Georgetown, SC 29442 - Effects of flooding and salinity stress on swamp tupelo (*Nyssa sylvatica*) and buttonbush (*Cephalanthus occidentalis*)

Buttonbush and swamp tupelo saplings were exposed to flooding and salinity conditions simulating the chronic exposure of sea level rise and the acute exposure of hurricane storm surges. Chronically exposed saplings were either watered or flooded with 0, 2, or 10 ppt salinity. Those in the acute exposure experiment were watered or flooded with freshwater until exposed to a 21 ppt salinity surge for 48 hours. Freshwater flooding reduced photosynthesis (A), leaf water potential (Ψ), height, stem and root biomass for swamp tupelo. Buttonbush root biomass decreased and stem biomass increased. Chronic watering with 2 ppt salinity reduced height, diameter, stem and root biomass for swamp tupelo but did not significantly affect buttonbush. Plants chronically flooded with 10 ppt salinity were most affected, with drastically decreased A , stomatal conductance (g_s) and Ψ within the first day of treatment and all dying within three weeks. Flooding with 2 ppt salinity also caused 100% mortality for swamp tupelo. All buttonbush saplings survived with reduced A , Ψ , stem and root biomass. Acute watering with 21 ppt reduced A , g_s and Ψ during the second day of the surge, with recovery in buttonbush after 20 days but not swamp tupelo. Flooding with 21 ppt also greatly impacted buttonbush, with no recovery after 20 days. Swamp tupelo was already stressed due to flooding and showed no further reduction due to the 21 ppt flood surge. Buttonbush was more tolerant of salinity and flooding conditions than swamp tupelo, although it is unlikely that either species could survive long term exposure to increased salinity.

- 261 MCLEOD, KENNETH W.¹, JAMES K. MCCARRON¹, AND WILLIAM H. CONNER². ¹Savannah River Ecology Laboratory, Aiken, SC 29802 and ²Baruch Forest Science Institute, Georgetown, SC 29442 - Flooding and salinity effects on four bottomland oak species.

Four oak species, differing in flood tolerance, were chronically (simulating sea level rise) and acutely (simulating hurricane storm surge) exposed to increased inundation and salinity. Photosynthesis(*A*), conductance and leaf water potential were temporally monitored. Oak seedlings demonstrated two response patterns. In overcup, Nuttall, and water oak, *A* was not reduced until two weeks after the initiation of the freshwater flooding, when compared to watered only. This impact increased with length of flooding. The first two of these oak species are moderately flood tolerant, while the latter is weakly to moderately flood tolerant. In swamp chestnut oak (weakly flood tolerant), *A* was immediately reduced by flooding with an increasing impact over time. As salinity increased to 2 ppt, regardless of whether watered or flooded, *A* of all species was reduced, but the respective species tolerances did not differ. All species died in 6 ppt salinity. When acutely exposed to 21 ppt salinity, the four oak species had severely reduced *A* regardless of whether the seedlings were flooded or watered. Flooded seedlings died within two weeks of the surge, while watered seedlings recovered and *A* was not reduced the following spring. As flooding of coastal areas increases due to sea-level rise, photosynthesis of these species will be differentially affected based primarily on their flood tolerance, regardless of salinity. This suggests that the flooding associated with sea-level rise is more important than small increases in salinity, and that high salinity accompanying storm surge will be very harmful to all of these species.

- 262 HACKNEY, COURTNEY T. AND KIMBERLY SCHLIPPER. University of North Carolina at Wilmington - Factors affecting the distribution of Spanish Moss, *Tillandsia usneoides* in Southeastern North Carolina.

Spanish moss has an irregular distribution in southeastern North Carolina. The Point Quarter method was used to select 50 random points in a reference and developed site. At each point four trees were selected and the following variables measured: degree of infestation, tree diameter, tree species, shading, canopy density and distance from the nearest structure. Only 56 of 200 trees were infested. Trees in the developed site had significantly higher ($P < 0.0005$) infestation levels. There was also a significant positive relationship ($P < 0.0148$) between tree diameter and degree of infestation in the maintained area. Surprisingly, the only significant relationship between Spanish Moss and the measured variables in the reference area was the distance of the host tree to a concrete structure. We propose that well drained Calcium deficient soils may limit the distribution of Spanish Moss, *Tillandsia usneoides*

- 263 AMANDA A. MCDONALD AND COURTNEY T. HACKNEY. University of North Carolina at Wilmington - The role of Calcium in the distribution of Spanish Moss, *Tillandsia usneoides* , in a developed landscape in Southeastern North Carolina.

The presence of Spanish Moss on trees was previously shown to be correlated with distance to concrete structures which may be important sources of Calcium in acidic soils of Southeastern NC. Pine needles and Spanish Moss growing with them were examined for Calcium content from sites various distances from concrete structures to determine if the relationship between concrete and Spanish Moss abundance was related to Calcium uptake.

- 264 COLLINS, BEVERLY AND GARY WEIN. Savannah River Ecology Laboratory - Effects of soil resource patchiness on vegetation structure.

Soil resource patchiness on newly abandoned fields may promote localized divergent rates and trajectories of vegetation change that are reflected in vegetation heterogeneity. We created checkerboard plots with high and low resource subplots of three sizes on two newly ploughed fields to test effects of soil resource patchiness. Composition and height of the canopy were censused 2, 4, and 6 yr after ploughing. On both fields, resource patchiness (subplot size) did not affect abundance or structure of the canopy. However, species sorting between fertilized and unfertilized checkerboards led to decreased cover heterogeneity among subplots and increased heterogeneity among plots on both fields. The later dominant on both fields,

Solidago altissima, was insensitive to the biotic neighborhood or patch size, but was more abundant on fertilized plots in one field and on unfertilized plots in the other. Plot enrichment promoted a more abundant, taller, and dichotomized canopy dominated by a single species. In general, soil fertility, but not patchiness, influenced canopy heterogeneity on the two fields.

- 265 WINSTEAD, JOE E. AND JOHN T. RILEY. Department of Biological and Environmental Sciences, Morehead State University, Morehead, KY 40351 and Department of Chemistry, Western Kentucky University, Bowling Green, KY 42101 - Soil and Vegetation changes over thirty-eight years on an orphan coal spoil bank in southeastern Ohio.

The vegetational development of an abandoned coal spoil bank in Vinton County, Ohio has been followed periodically since colonization by native species following mining in 1958. Permanent plot soil samples along a 40 meter transect collected at 5 and 10 year intervals indicate consistent levels of Sulfur in the developing top soil averaging 0.12% that are 10 fold higher than undisturbed soil samples. There has been a general pattern of change of soil pH to being less acidic with an increase in Nitrogen levels. Tree growth and cover appear to be controlled by slope and stability of the spoil with Sycamore, Tulip Poplar and Red Maple comprising the dominant species. The harsh environment of remaining areas not developed by tree cover show early colonizers dominated by *Solidago* sp. and *Rubus* sp. along with *Andropogon virginicus*.

- 266 WALKER, GARY L. Appalachian State University - Disjunct cliff face populations of northern white cedar, (*Thuja occidentalis* L.), as genetic repositories during interglacial periods.

Several hypotheses have been proposed regarding the distribution of genetic variation across species' ranges. Both main range and disjunct populations have been suggested as having higher levels of genetic variability. Many populations of disjunct species have been observed in cliff-face communities. Northern white cedar is considered a boreal relict species in its southern disjunct range and is often found on cliff-faces. Main and disjunct range populations of northern white cedar were surveyed for allozyme variability. Levels of observed heterozygosity were higher in southern disjunct range populations than main range populations. Alleles rare or absent in the main range were found at higher frequencies in some disjunct populations. Analysis of microgeographic genetic structure in southern disjunct populations revealed nonrandom clustering of highly heterozygous genotypes indicating use of alternative breeding systems in some stands.

- 267 YOUNG, JOHN M. Appalachian State University -- The ecology and genetic structure of northern white cedar (*Thuja occidentalis* L.) cliff populations in its southern disjunct range.

In the southern portion of its disjunct range, northern white cedar (*Thuja occidentalis* L.) is a glacial relict that typically occurs on north-facing, limestone cliffs along deeply entrenched stream and river valleys. Cliff *Thuja* populations occur across a mosaic of physiographic provinces that comprise a heterogeneous landscape of variable topographic, lithologic, and climatic conditions. Habitat heterogeneity is observed within cliff sites, where *Thuja* stems occur on sheer cliff faces and less frequently along thin corridors of cliff top and/or cliff bottom habitat. I sampled and described the cliff environment for eight *Thuja* sites from April to October of 1994 using 10 m wide horizontal and vertical belt transects. Leafy twig tissue was collected at each site from all individual stems occurring within transect boundaries. Eleven allozyme loci were used to describe the genetic structure within and among cliff populations. I found significant environmental differences in soil pH and nutrient concentrations within and among cliff *Thuja* sites. Environmental heterogeneity within sites supported two distinct microhabitats - the cliff top and cliff face - across all sites examined. Patterns of genetic structure among cliff populations indicate that genetic drift following population fragmentation and differential rates of northward migration among physiographic provinces throughout the present interglacial period may have had a pronounced effect on the distribution of genetic variation. Moreover, these data suggest that the effects of genetic drift were probably less severe in physiographic provinces containing a greater abundance of suitable habitat and/or natural north-south oriented corridors of migration. A significant partitioning of genetic information within populations suggests that stems occurring on the cliff face contain greater genetic variation than those on the cliff top.

- 268 CLEBSCH, EDWARD E. C. The University of Tennessee, Knoxville
- Plant disjunctions in cliff face communities.

Documented disjunctions in different landscapes, river systems, and geologic and climatic regions of the southeastern U.S. are reviewed. The case for boreal post-Pleistocene relicts is developed, and the few austral disjuncts are detailed. The question of why rarities in some cliff habitats are endemics while those in others are disjuncts is addressed. Fruitful areas for further investigation are presented.

- 269 LARSON, D.W., Dept. Of Botany, University of Guelph, Ont.,
Canada - Progress and opportunities for cliff ecology at the small and large scale.

Cliffs are extremely common landscape elements in the world and are appreciated by the public at large. They form key components of national parks and nature reserves. Despite this, they are rarely exploited as objects of scientific study. This is unfortunate since cliffs represent land that has been little influenced by direct human disturbance. In this presentation I will briefly illustrate the progress we have made in asking ecological questions at a variety of temporal and spatial scales. I will show that the work yields results with surprising amounts of predictive capacity at these different scales. The work has shown that cliffs of the Niagara Escarpment support an ancient forest dominated by Thuja occidentalis and a wide variety of stress-tolerant lower and higher plants. Predictions made by other researchers about the form and location of ancient undisturbed forests in the landscape are confirmed by our work. Our results suggest that cliffs may be habitats that have been overlooked when sites are being sought to test different components of modern ecological theory. I will conclude by suggesting that an international effort be raised to examine the ecology of cliffs.

- 270 COCKING, W. DEAN. Department of Biology, James Madison University - Active learning and projected computer presentation packages in large lecture biology classes.

This workshop will consist of one hour of demonstration presentations of ways that projected computer based software is actually being used in large lecture biology classes such as general botany, non-majors biology, and introduction to ecology by individuals who have put it into use on a full-time basis. Particular emphasis will be placed on how the individual teachers use the computer to do things that supplement traditional techniques and promote active learning. The presentations will be followed by an open discussion of the use of instructional technologies in large lecture situations. Those in attendance will be encouraged to briefly comment on their own innovations, implementation activities, and the problems and successes that were part of their exploration of this medium. Instructional technology is seen by some as a way to 'save money' and 'teach more with less.' The validity of this position is a subject for exploration.. There is a 'reality gap' between the dreams of those who are fascinated by the medium and promoting these technologies and the classroom teacher who has to develop the presentations with limited time and resources. Questions by those individuals who are contemplating using computer based presentations and want to avoid disaster will be welcomed.

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IN THIS ISSUE

THE ASB BULLETIN

VOLUME 44, NUMBER 2, APRIL 1997

Program of the 58 th Annual Meeting	27
General Information	30
ASB Candidates for Office	32
Plenary Speaker	37
Program Summary	38
Floor Plan of the Hyatt Regency Meeting Facilities . .	40
Poster and Paper Sessions	41
Beta Beta Beta Paper Sessions	66
Author Index	69
Reviews	71
News of Biology in the Southeast	73
Abstracts of Poster and Paper Sessions	77

The ASB BULLETIN

Volume 44, Number 3

July 1997

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. 44
o. 3
uly 1997



A demonstration of the ability of subcuticular brittlestar bacteria to inhibit the growth of human pathogenic bacteria. Control plate shows eight species of human pathogens grown in the absence of brittlestar bacteria. Lower plate shows the same species grown in the presence of brittlestar bacteria (horizontal streak.) Research by Bill Dobson, Leon Lundie and Eileen Strahl, Appalachian State University.

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rhaynes@biology.as.ua.edu

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Dwayne Wise, Dept. of Biol. Mississippi State University, Drawer GY, Mississippi State, MS 39762-5759;
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2000 Patricia Cox, Div. of Biol., 301 Hesler Hall, University of Tennessee, Knoxville, TN 37996; (423)974-6225;
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Terry Richardson, Dept. of Biol. UNA Box 5212, University of North Alabama, Florence, AL 35632-0001;
(205)760-4429; trichard@unanov.una.edu

PURPOSE

The purpose of this association shall be to promote the advancement of biology as a science by encouraging research, the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. Members receive the *ASB Bulletin*.

TIME AND PLACE OF FUTURE MEETINGS

1998	April 15-18	Northeast Louisiana University, Monroe, LA
1999	April	University of North Carolina at Wilmington, Wilmington, NC
2000	April	University of Tennessee at Chattanooga, Chattanooga, TN

PRESIDENT'S CORNER

A VIEW FROM HERE

Students are the fuel and ultimate energy source for any scientific organization. Thus, the organizational strength of ASB tomorrow will depend on the level of student involvement today. For this reason, we must make concerted efforts to enhance student membership in the Society and participation in annual meetings.

Student participation at ASB meetings strikes a tenuous balance. To me, one disappointment at the 1997 meeting was that few students attended the opening Plenary Session. Another was the surprising absence of students during the presentation of awards at the banquet. An additional low point at the banquet came when one student award was not given because no student had signed up for the competition.

On the positive side, dozens of students presented talks at the meeting, most of them excellent. So, perhaps any concern about student involvement is unwarranted. Maybe student attendance at the Plenary Session has always been shy. Maybe student award winners have seldom attended the banquet. Maybe the beginning and ending sessions are not satisfactory barometers of student involvement.

But what if student participation is a problem? What can we do to make involvement in the Society and attending meetings more conducive to students? Offer travel grants? Give special student membership rates? Encourage local chairs to find low-priced lodging and offer reductions in the cost of special events (such as banquets) at meetings? But we already do all of these, although maybe we should take a close look to see if we could do something better. I think the inducement that is really needed is on the part of faculty to provide an incentive on professional grounds.

What do you say to a student who asks what the advantages are of belonging to ASB? ASB provides a forum to present one's first and additional scientific papers to a professional audience, without the intimidation factor characteristic of large national meetings, and to become educated concerning important trend in biological sciences and issues that impact our field. Opportunities abound for interacting, networking, communicating with colleagues (or future colleagues) in academia, state and federal agencies, and private industry, and to accord colleagues due recognition of their achievements. ASB offers opportunities to meet the people that influence jobs that many students soon will be seeking. A final reason, one that holds for all of us, is that one can join in association with other southeastern biologists to influence decisions that affect environmental and other biological actions in the Southeast and the nation.

Opportunities to give formal presentations, to interact with professional colleagues, and to find out how a scientific meeting is supposed to be run--all are benefits provided by ASB. The time to become involved in ASB is when one is

a student. The time for faculty to become involved in encouraging students to participate in ASB is now.

I suggest that each ASB faculty member recruit one student member to join ASB and attend the meeting next April. Let's make 1997-98 the Year of the Student. Students are the most important resource we have, and we need them to maintain the ASB as a sustainable professional scientific community.

Sincerely,
Whit Gibbons, President
Association of Southeastern Biologists



Jim Fralish passes the gavel and the presidency to Whit Gibbons

ASSOCIATION AFFAIRS

ASB OFFICERS, COMMITTEES AND REPRESENTATIVES AND *ASB BULLETIN* STAFF, 1997 - 1998

Telephone numbers, FAX numbers and E-mail addresses
can be found on the inside front cover of each issue of the *ASB Bulletin*.

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Vice-President	Howard Neufeld, Department of Biology, Appalachian State University, Boone, NC 28608
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Phil Robertson, Dept. Plant Biol., So. Ill. Univ., Carbondale, IL 62901
- 1999: Doug Rayner, Dept. of Biology, Wofford College, Spartanburg, SC 29301
Dwayne Wise, Dept. of Biol. Miss. State Univ., Drawer G, Mississippi State, MS 39762-5759
- 2000: Patricia Cox, Div. of Biol., 301 Hesler Hall, Univ. of Tenn., Knoxville, TN 37996.
Terry Richardson, Dept. of Biol., UNA Box 5212, Univ. of North Alabama, Florence, AL 35632-0001.



Some of the officers of ASB. Left to right: Howard Neufeld, Andrew Ash, Gerhard Kalmus, Whit Gibbons, Robert Haynes, Patricia Cox, Terry Richardson, Eloise Carter, Jim Fralish and Ken Shull.

ASB Committees

AAAS Representative (Section G) - James W. Ross, Biol. Dept., 7196 College Station Dr., Cumberland College, Williamsburg, KY 40769-1382, (606)549-4380.

AIBS Representative - Geraldine Twitty, Biol. Dept., Howard University, Washington, DC 20059 (202)806-6953, FAX(202)806-4564.

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Committee on Women, Minorities and the Disabled - Chair: Patricia Parr, Oak Ridge National Laboratory, PO Box 2008, Oak Ridge, TN 37831-6034 (423)576-8123; Heather Owen, Dept. of Biol., Western Kentucky University, #1 Big Red Way, Bowling Green, KY 42101, (502)745-6501; Henry Bart, Tulane Museum of Natural History, Belle Chasse, LA 70037 (504)821-5145.

Conservation Committee - Chair: David D. Taylor, USDA Forest Service, 1835 Big Hill Rd., Berea, KY 40403, (606)986-8434; E. Wayne Chester, Dept. of Biol., Austin Peay State University, Clarksville, TN 37044, (615) 648-7781; Gary Walker, Dept. of Biol., Appalachian State University, Boone, NC 28608 (704)262-2672.

Education Committee - Co-chair: Beverly A. Knauper, Biol. Dept., Raymond Walters College, University of Cincinnati, 9555 Plainfield Rd., Cincinnati, OH 45236, (513)745-5618; Edward D. Mills, Wingate College, Box 2508, Dept. of Biol., Wingate, NC 28174, (704)233-8239; Rich Kopp, Dept. Biol. Sci., Georgetown College, Georgetown, KY 40324-1696, (502)836-8087; Francis Kennedy, Dept. of Biol., Agnes Scott College, Decatur, GA 30030, (404)371-6367; John Alif, DeKalb College, Decatur, GA 30243, (404)339-2328; Herbert House, Dept. of Biol., Elon College, Elon College, NC 27244, (910)584-2294.

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Local Arrangements and Program Committee for 1998 - (All in the Department of Biology, Northeast Louisiana University, Monroe, LA 71209) Chair: Kim Tolson, (318)342-1805, bitolson@alpha.nlu.edu; Program Chair: Frank Pezold, (318)342-3103, bipezold@alpha.nlu.edu.

Meritorious Teaching Award Committee - Chair: Ken W. McLeod, Savannah River Ecology Lab, P.O. Drawer E, Aiken, SC 29802, (803)725-3309; Robert F. McGuire, Biol. Dept., University of Montevallo, Station 6463, Montevallo, AL 35115, (205)665-6463. Ron Dimock, Wake Forest University, Winston-Salem, NC 27106-5848, (910)759-5567.

Nominating Committee - Chair: Jim Ross, Biol. Dept., 7196 College Station Dr., Cumberland College, Williamsburg, KY 40769-1382, (606)549-4380; Rebecca Sharitz, Savannah River Ecology Laboratory, P.O. Drawer E, Aiken, SC 29802, (803)725-2472.

Past-Presidents' Council - Chair: James W. Ross, Biol. Dept., 7196 College Station Dr., Cumberland College, Williamsburg, KY 40769-1382, (606)549-4380.

Place of Meeting Committee - Chair: B. Eugene Wofford, Botany Dept., University of Tennessee, Knoxville, TN 37996, (615)974-6212; James B. Claiborne, Dept. of Biol., Georgia Southern University, Statesboro, GA 30460-8042, (912)681-5496; Joe Pollard, Dept. of Biol., Furman University, Greenville, SC 29613, (864)294-3244.

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Publications Committee - Chair: Philip A. Robertson, Dept. of Plant Biol., Southern Illinois University, Carbondale, IL 62901, (618)536-2331; Douglas R. Rayner, Dept. of Biol., Wofford College, Spartanburg, SC 29301, (864)597-4624; Ross Hinkle Bionetics, Bio-2, Kennedy Space Center, FL 32899, (407)853-3281; Ken Shull, Jr., (*ex officio*) Dept. of Biol., Appalachian State University, Boone, NC 28608, (704)262-2675; Gerhard Kalmus, (*ex officio*) Dept. Biol., East Carolina University, Greenville, NC 28785, (919)328-6306.

Research Awards Committee-Faculty - Chair: Dwayne A. Wise, Dept. of Biol. Sci., Mississippi State University, Mississippi State, MS 39762, (601)325-7579; Robert Haynes, Dept. of Biol., University of Alabama, Tuscaloosa, AL 35487; (205)348-1826.

Research Awards Committee-Student - Chair: Jeri W. Higginbotham, Biol. Dept., Jacksonville State University, Jacksonville, AL 36265-9882, (205)782-5638; Paul A. Schmalzer, The Bionetics Corp., Mail Code Bio-2, Kennedy Space Center, FL 32899, (407)853-3281; Lew Stratton, Biol. Dept., Furman University, 3300 Poinsett Highway, Greenville, SC 29613-0418, (864)294-3249.

Resolutions Committee - Chair: James W. Ross, Biol. Dept., 7196 College Station Dr., Cumberland College, Williamsburg, KY 40769-1382, (606)549-4380; Dwayne Wise, Dept. of Biol. Sci., Mississippi State University, Mississippi State, MS 39762, (601)325-7579; Frank Pezold, Dept. of Biol., Northeast Louisiana University, Monroe, LA 71209, (318)342-3103.

Ad Hoc Committees:

Demography and Patterns of ASB Membership - Patricia Cox, Division of Biology, 301 Hesler Hall, University of Tennessee, Knoxville, TN 37996, (423)974-6225.

ASB Logo - James Fralish, Dept. of Forestry, So. Illinois University, Carbondale, IL 62901, (618)453-7466.

ASB Web Site - Howard Neufeld, Dept. of Biol., Appalachian State University, Boone, NC 28607, (704)262-2683.

**RESOLUTION OF APPRECIATION TO
FURMAN UNIVERSITY, FACULTY, STAFF,
STUDENTS AND LOCAL ARRANGEMENTS COMMITTEE
FROM THE ASSOCIATION OF SOUTHEASTERN BIOLOGISTS**

WHEREAS, Furman University and its President, David E. Shi, graciously invited the Association of Southeastern Biologists to hold its 58th Annual Meeting at the Hyatt Regency in Greenville, South Carolina on April 16 - 19, 1997; and

WHEREAS, the University and immediate community have extended to the membership of the Association cooperation and assistance in addition to hospitality and friendship; and

WHEREAS, the Local Arrangements Chair, Lew Stratton, Program Chair, Joe Pollard and other chairs and organizers, Irene Kokkala, John Snyder, Wade Worthen, Laura Thompson, Bill Blaker, Dennis Haney and Helen Stratton, the Department of Biology, staff and students have given generously of their time, expertise and enthusiasm to organize and conduct a productive and enjoyable meeting;

THEREFORE BE IT RESOLVED, that the members of the Association of Southeastern Biologists express their gratitude and respect to Furman University and the Department of Biology for contributing to the continued success of our organization.

NOTE FROM THE EDITOR

Please forgive the delay in receiving your July issue of the *ASB Bulletin*. Due to a computer failure (loss of the hard drive) the copy was not sent to Allen Press until 10 July 1997. Hopefully the problem is now corrected and the future issues will get to you on time.



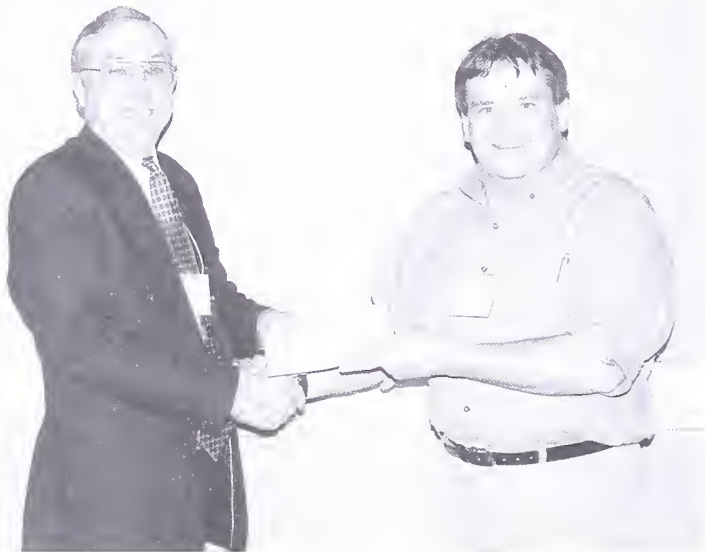
1997 RESEARCH AWARD RECIPIENTS

ASB SENIOR RESEARCH AWARD: sponsored by The William C. Brown Publishing Co. was presented by Larry Barden to Paul and Hazel Delacourt, Professors of Ecology and Evolutionary Biology at the University of Tennessee, Knoxville, for their paper: "Prehistoric pyromaniacs in the southern Appalachian oak-chestnut forest region". *ASB Bul. Abstr.* 97, 44(2), 1997.

STUDENT RESEARCH AWARD: supported by the Martin Microscope Co. of Easley, SC was presented by Terry Richardson to Amy Norris for her paper: "Silica content of intertidal marshes in the Cape Fear River Estuary, North Carolina". *ASB Bul. Abstr.* 226, 44(2), 1997 co-authored with Courtney Hackeny. Ms. Norris is a graduate student at the University of North Carolina, Wilmington, Wilmington, NC.

ASB POSTER AWARD: The first annual ASB Poster Award was presented by Robert Haynes to Adrienne Lickey and William E. Dobson of Appalachian State University for their poster: "Effects of environmental factors on ossicle banding patterns in *Amphiopholis gracillima*". *ASB Bul. Abstr.* 4, 44(2), 1997.

SE DIVISION, AMERICAN SOCIETY ICHTHYOLOGISTS AND HERPETOLOGISTS AWARD: in ichthyology was presented by Floyd Scott to Kyle R. Piller of the Department of Zoology, Southern Illinois University, Carbondale, IL and the Tulane Museum of Natural History, Belle Chasse, LA. for his paper: "Status survey of the sturgeon chub, *Macrhybopsis gelida*, and the sticklefin chub, *M. meeki*, in the middle Mississippi River, Illinois". *ASB Bul. Abstr.* 248, 44(2), 1997 Co-authors were David J. Eisenhour and Brooks M. Burr, both of Southern Illinois University, Carbondale, IL.



Bill Dobson accepts the first annual ASB Poster Award for Adrienne Lickey and himself from Robert Haynes



John Aho presents the Eugene P. Odom Award to Samara Hamze

SE SOCIETY OF PARASITOLOGISTS BYRD - DUNN AWARD: for the outstanding paper given at ASB in the field of parasitology was presented by John Aho to Derek A. Zelmer of Wake Forest University, Winston-Salem, NC for his paper: "The role of habitat in the structuring of the *Halipegus occidialis* metapopulation of the green frog *Rana clamitans*". *ASB Bul. Abstr.* 145, 44(2), 1997. Co-authors were Eric J. Wetzel (Wabash College) and Gerald W. Esch (Wake Forest Univ.)

EUGENE P. ODOM AWARD: (\$250/plaque) was presented by John Aho to Samara Hamze for her paper: "The distribution of seedlings of the Great Lakes endemic *Cirsium pitcheri*". *ASB Bul. Abstr.* 175, 44(2), 1997 co-authored with Claudia L. Jolls. Ms. Hamze is a graduate student at East Carolina University, Greenville, NC. Receiving Honorable Mentions were Christine J. Small (*ASB Bul. Abstr.* 90, 44(2), 1997) and J. Todd Petty (*ASB Bul. Abstr.* 251, 44(2), 1997)

SOUTHERN APPALACHIAN BOTANICAL SOCIETY AWARDS:

RICHARD AND MINNIE WINDLER AWARD

The Richard and Minnie Windler Award recognizes the best systematic botany paper published in *Castanea*, The Journal of the SABS, in the past year. The award for 1996 was presented by John Herr to Daniel Brunton (Ottawa, Ont., Canada,) Donald M. Britton (Dept. of Mol. Biol. and Genetics, Univ. of Guelph, Guelph, Ont., Canada) and Thomas F. Wieboldt (Dept. of Biol., Va. Polytechnic Inst. and State Univ., Blacksburg, VA.) for their paper: "Taxonomy, Identity and Status of *Isoetes virginica* (Isoetaceae)". *Castanea* 61(2):145-160. June 1996.

ELIZABETH ANN BARTHOLOMEW SERVICE AWARD

The Elizabeth Ann Bartholomew Award is presented to individuals who have distinguished themselves in professional and public service that advances our knowledge and appreciation of the world of plants and their scientific, cultural and aesthetic values. This award was presented by Andy Ash to Donna Ware, College of William and Mary, Williamsburg, Va.

SABS STUDENT RESEARCH GRANTS

THE SABS STUDENT RESEARCH GRANTS are competitive awards for graduate research in plant science. Two awards of \$300 each were presented by Larry Mellinchamp to Samara Hamze of East Carolina University, and Kerry Heafner of Old Dominion University.

NORTH CAROLINA BOTANICAL GARDEN AWARD was presented by Dan Pittilo to J. Eric Davis and Larry Barden of the University of North Carolina, Charlotte for their paper: "Restoration of a Piedmont prairie: potential species composition and demographics of the federally endangered sunflower, *Helianthus schweinitzii* T&G (Asteraceae)". *ASB Bul. Abstr.* 177, 44(2), 1997.

STUDENT RESEARCH AWARD IN AQUATIC BIOLOGY: sponsored by Wildlife Co. (Wildco) was presented by Terry Richardson to Amy R. Norris of the University of North Carolina, Wilmington, NC for her paper: "Silica content of intertidal marshes in the Cape Fear River Estuary, North Carolina". *ASB Bul. Abstr.* 226, 44(2), 1997 co-authored with Courtney Hackney.

SPECIAL AWARD TO DR. JOHN HERR

The Association of Southeastern Biologists presented a special award to Dr. John Herr of the University of South Carolina for his exemplary work on the new Constitution and By-Laws of the organization. Dr. Herr has contributed much to the organization over the years and worked long and hard on the new documents. Without him we would not have the much needed revisions. ASB thanks Dr. Herr for all he has done for the organization.



Jim Fralish presents a special award to John Herr

DEATHS OF ASB MEMBERS IN 1996

R. F. Gordon

EMERITUS MEMBERSHIP

At the annual business meeting the following members were granted Emeritus status:

J. D. Satterfield, J. F. Matthews, T. D. Kimbrough,
R. M. Grodner, J. F. Breeden, E. Feil, C. W. Hart

STUDENT SUPPORT AWARD RECIPIENTS

Eric Adams - Southern Illinois Univ. 166
Jennifer Aderman - Marshall Univ. 58
Mike Barnwell - Jacksonville St. Univ. 18, 114
Mark Basinger - So. Illinois Univ. 168, 169
Eric Blackwell - Jacksonville St. Univ. 208
Kevin Brittingham - Marshall Univ. 220
Janie Brooks - Cornell Univ. 106
Cynthia Caplen - Texas Tech Univ. 157
Mike Gaugler - East Tennessee St. Univ. 126
Wanda Goleman - Northeast Louisiana Univ. 12
Ashley Hamilton - Auburn Univ. 225
Mike Harrell - Northeast Louisiana Univ. 5
Andrea Henry - Marshall Univ. 57

Robert Hood - Marshall Univ. 219
Roger McCoy - Southern Illinois Univ. 187
Thomas McElroy - Mississippi St. Univ. 136
Matt McReynolds - Marshall Univ. 52
Erica Midkiff - Marshall Univ. 215
Gail Perrine - Marshall Univ. 118
Jennifer Robertson - Appalachian St. Univ. 43
Sharon Suchecki - Southern Illinois Univ. 162
Robert Tucker - Marshall Univ. 141
Warren Weaver - Southern Illinois Univ. 224
Eric Wilhelm - Marshall Univ. 66, 221
Denise Williams - Appalachian St. Univ. 44

EDITOR'S REPORT FOR 1997

A total of 234 pages (vs. 244 for 1995) were published in the *ASB Bulletin*, vol. 43. There were two full research papers published for a total of ten pages. Society items, book reviews (21), News of the Southeast and abstracts (275) accounted for the balance of the volume. We are now submitting the entire volume in "camera-ready" form, which produces a substantial savings in cost of publishing the *Bulletin*.

GREENVILLE MEETING WRAP-UP

Seven hundred and sixty-five people registered at the 58th annual meeting at Furman University in Greenville, South Carolina. Student registration totaled 354, or 46% of those registering. The registrants represented 122 academic institutions and 55 other institutions (commercial/agency/government/private.) Over 25 states were represented. There were 236 papers and 34 posters presented at the ASB meetings and an additional five posters and 30 papers presented at the Beta Beta Beta meeting. The society appreciates the work that went into such a successful meeting.

**THE ASSOCIATION OF SOUTHEASTERN BIOLOGISTS
TREASURER'S REPORT
1 JANUARY - 31 DECEMBER 1996**

I. BEGINNING BALANCE		\$32,070.58
II. RECEIPTS		
Regular Dues	\$12,375.00	
Patron Memberships	\$2,000.00	
Interest	1,529.69	
N.C. Botanical Garden	100.00	
Wildco	200.00	
BSA Reimbursement	250.00	
Meeting Revenue	12,006.46	
Exhibition Fees, T-Shirt Sales, Registration		
Sales	7.00	
Enrichment	1,005.00	
TOTAL RECEIPTS		\$29,473.15
III. TOTAL RECEIPTS AND BEGINNING BALANCE		\$61,543.73
IV. DISBURSEMENTS		
1. MEMBERSHIP	\$31.11	
2. PUBLICATION		
<i>ASB Bulletin</i> 43(1)	3,117.86	
<i>ASB Bulletin</i> 43(2)	7,371.82	
<i>ASB Bulletin</i> 43(3&4)	5,451.91	
Miscellaneous	544.81	
TOTAL PUBLICATION	16,486.40	
3. OFFICE EXPENSES	474.88	
4. OFFICIAL TRAVEL	698.58	
5. AWARDS AND HONORARIA		
Graduate Student Support Grants	3,216.00	
N.C. Botanical Garden Award	100.00	
Aquatic Biology Award	200.00	
Speaker Travel	200.00	
ASB Research Award	500.00	
Student Research Award	500.00	
Certificates/Plaques	62.70	
TOTAL AWARDS	4,778.70	
6. MISCELLANEOUS		
AIBS Affiliation	290.10	
Association of Systematics Collection	100.00	
Symposium	900.00	
Local Committee	2,421.79	
Bank Charges, Refunds	32.00	
TOTAL MISCELLANEOUS	3,743.89	
TOTAL DISBURSEMENTS		\$26,215.56
V. ENDING BALANCE		\$35,328.17
VI. NET CHANGE FOR 1996	\$ 3,257.59	

**THE ASSOCIATION OF SOUTHEASTERN BIOLOGISTS
1997 PROPOSED BUDGET**

I.	BEGINNING BALANCE		(ASSUME)	\$32,000.00
II.	RECEIPTS			
	Regular Dues		\$18,450.00	
	Patron Memberships		\$2,500.00	
	Interest		1,100.00	
	N.C. Botanical Garden		100.00	
	Wildeo		200.00	
	BSA Reimbursement		250.00	
	Meeting Revenue:			
	Exhibition Fees		3,000.00	
	Sales		250.00	
	Registration		6,000.00	
	Page Charges		100.00	
	TOTAL RECEIPTS			\$31,950.00
III.	TOTAL RECEIPTS AND BEGINNING BALANCE			\$63,950.00
IV.	DISBURSEMENTS			
1.	DUES NOTICE	\$500.00	500.00	
2.	PUBLICATION			
	<i>ASB Bulletin</i> 43(1)	4,000.00		
	<i>ASB Bulletin</i> 43(2)	9,000.00		
	<i>ASB Bulletin</i> 43(3)	4,500.00		
	<i>ASB Bulletin</i> 43(4)	3,000.00		
	Misc. Publications	200.00		
	TOTAL PUBLICATION		20,700.00	
3.	OFFICE EXPENSES	500.00	500.00	
4.	OFFICIAL TRAVEL	1,000.00	1,000.00	
5.	AWARDS AND HONORARIA			
	Graduate Student Support Grants	4,000.00		
	N.C. Botanical Garden Award	100.00		
	Aquatic Biology Award	200.00		
	Speaker Honorarium	500.00		
	Speaker Travel	500.00		
	Research Awards	1,200.00		
	Certificates/Plaques	150.00		
	Poster Award	300.00		
	TOTAL AWARDS		6,950.00	
6.	MISCELLANEOUS			
	Affiliations	400.00		
	Local Committee	500.00		
	Symposia, Workshops	1,200.00		
	Bank Charges	200.00		
	TOTAL MISCELLANEOUS		2,300.00	
	TOTAL DISBURSEMENTS			\$31,950.00
V.	NET BALANCE FOR YEAR			0.00
VI.	BALANCE FORWARDED			\$32,000.00

**THE ASSOCIATION OF SOUTHEASTERN BIOLOGISTS
ENRICHMENT FUND
1 JANUARY - 31 DECEMBER 1996**

I.	BEGINNING BALANCE		\$18,413.00
II.	RECEIPTS		
	1. GIFTS	\$3,645.00	
	2. INTEREST	987.00	
	TOTAL		\$4,632.20
III.	TOTAL RECEIPTS AND BEGINNING BALANCE		23,045.00
IV.	TOTAL DISBURSEMENTS		900.00
V.	ENDING BALANCE		\$22,145.00
VI.	NET CHANGE FOR 1996		\$3,732.00

**CASH ON HAND
December 31, 1996**

	ASB Fund	Enrichment	Total
Merrill Lynch			
CMA Money Fund	\$31,981.00	0.00	31,981.00
CMA Cash	1.81	0.00	1.81
Government Securities	0.00	22,145.00	22,145.00
Subtotal	31,982.81	22,145.00	54,127.81
Wachovia Bank	4,743.04	0.00	4,743.04
Total	36,725.85	22,145.00	\$58,870.85

CHANGES IN ADDRESSES, ZIP CODES AND AREA CODES

From time to time the post office changes ZIP Codes, the telephone companies add or change area codes for some cities, and addresses change due to cities and towns adopting 911 emergency service. The names and addresses of all ASB committee members appear in this issue of the *ASB Bulletin*. If you serve on an ASB committee or are an officer in the Association and your address, ZIP Code or Area Code has changed in the past year, please notify the editor so that the information can be corrected in the next issue of the *ASB Bulletin*. All members should send any change of address to the treasurer as soon as the change becomes effective. The *ASB Bulletin* is sent to you according to the address on file with the treasurer.

CALL FOR PAPERS AND IMPORTANT DEADLINES

THE 59th ANNUAL MEETING

HOST: NORTHEAST LOUISIANA UNIVERSITY

MONROE, LOUISIANA

DATE: 15-18 APRIL, 1998

Please note the following deadlines which are to be met for our 59th Annual Meeting hosted by Northeast Louisiana, Monroe, Louisiana.

- 15 November, 1997 . . Nominations for ASB officers and executive committee.
- 15 November, 1997 . . Titles and abstracts of papers and posters. They must reach the program chair by this date. Use the blue abstract forms that will be in the October issue of the *ASB Bulletin*.
- 15 November, 1997 . . Application for senior and student research awards.
Full papers due by 15 January, 1997.
- 15 January, 1998 Receipt of manuscripts and application materials for Senior Research Award.
- 15 January, 1998 Receipt of manuscripts and application materials for Student Research Award and Student Research Award in Aquatic Biology.
- 1 February, 1998 Application for graduate student support awards.
- Anytime Membership application. Application forms are found on the inside back cover of each issue. Encourage your graduate students, colleagues and your institutional librarian to join.

SPECIAL CALL FOR NOMINATIONS AND AWARDS APPLICATIONS

As at all Annual Meetings of the Association, the membership at the April 1998 Annual Meeting will recognize outstanding research and meritorious teaching among the members of ASB. As President Whit Gibbons pointed out in "The View From Here" column (pg. 155 in this issue,) in the past few years several awards have gone without recipients because the membership failed to apply for them or nominate other ASB members for the awards. *Now is not too early to consider entering your papers or the papers of your students in the competition for the many awards given at the annual meeting or nominating excellent teachers you have had in the past for the Meritorious Teaching Award!* The deadlines are not onerous and the requirements for the awards can be met by most members in their respective fields. While details concerning applications for the awards do not appear until the October issue, you can begin to think about applying for the awards now. Urge your students to do the same.

ANNOUNCEMENTS

SPECIAL NOTICE FROM THE EDUCATION COMMITTEE

At the 1998 ASB meeting the Education Committee will sponsor a session concerning successful, innovative lab exercises that work well on a small budget. Each presenter will describe the exercise and have copies of the protocol to share. In order to plan the session, the Education Committee is asking all interested presenters to submit a description of the specific exercise for consideration to Edward Mills, Wingate College, Box 2508, Department of Biology, Wingate, NC 28714, by September 1, 1997.

RESOLUTIONS RULES

If you have a resolution you wish to have presented to the ASB membership in the business session of the April meeting you *must* have the resolution to Jim Fralish two weeks before the April Meeting. See the inside front cover for the address.

ASB INVOLVEMENT IN AAAS

ASB is an affiliate of AAAS and, as such, has a representative to that organization. If you are active in AAAS and would be interested in representing ASB in that AAAS, please contact the president, Whit Gibbons.



Kerry Heafner and Samara Hamze, recipients of the SABS Student Research Grants

REVIEWS

Nicholas J. Gotelli and Gary R. Graves. 1996. Null Models in Ecology. Smithsonian Institution Press 368 pp. \$65 cloth \$30 paper.

This book presents the Tallahassee perspective on null models in ecology, specifically, randomization tests for patterns in community ecology. Chapters review previous work on diversity and abundance, size ratios and niches, co-occurrence, species area and biogeography, and food webs, and each chapter concludes with a paragraph of recommendations. The preface notes that one's opinion of this book may be determined by one's prejudices for or against this form of null models. As a proponent of informed use of randomization tests, I find this book a good index to much of this literature, but inadequate as both a synthesis of lessons learned and as a guide to future applications of null models.

The traditional statistical concepts of null hypotheses are outside the aims of this book, yet it suffers from a lack of statistical theory at several levels. There are minor shortcomings: for example the introductory philosophical chapter claims that the failure to reject a null model is grounds for concluding that a mechanism is not operating; lack of statistical power is mentioned only as a property of "flawed" null models, not of inadequate sample sizes. More seriously, the theoretical concepts of sufficient and ancillary statistics and the conditionality of tests could provide a framework for assessing the validity of randomization tests.

Null models should include the effects of all factors except the factor of interest, for example differences in vagility and population density and habitat requirements and source populations but not competition. Unfortunately, randomization tests conditioned on the observed data are null models of sampling processes, not directly of ecological processes, and this book does not make the distinction clear. A null model of ecological processes A, B, and C but not D usually does not directly map onto a sampling null model of constraints 1,2, and 3 but not 4. My sense is that for null models ranging from rarefaction curves to size ratios to coexistence, the connection between the null ecological factor model and the null sampling model determines the validity of any null model approach. It is difficult to specify correctly the appropriate randomization or bootstrap for complicated sampling problems; it is not always possible to tie a biological process to a sampling process.

Instead of such a conceptual framework, each chapter provides a collection of null models, specific criticisms of each and occasional rejoinders, and then rather facile prescriptions of specific techniques or approaches. For example, rarefaction curves and hypergeometric confidence intervals about them are presented as the be-all and end-all of diversity measures. This may be true enough for studies of vertebrates and vagile animals but is not true for vegetation, and both this distinction and the reason for the distinction are omitted. The "null model" of independent and equiprobable sampling of individuals is inappropriate for vegetation sampling (and questionable for the original Sanders benthic sampling) based on quadrats rather than individuals. This problem is addressed only obliquely in terms of randomness of the spatial distribution of individuals, and the recommendation is to treat the individuals as spatially random and thus independently sampled "unless a great deal of information is available on the spatial organization of the assemblage" (p. 28). Valid scale-dependent approaches to plant diversity exist, yet the reader is neither explicitly warned of the differences for plants versus animals nor pointed in the right direction. Similarly, for species co-occurrences, Jackson et al. (1992) is cited in another context, but its randomization procedures are ignored and a new procedure is recommended. The new procedure may or may not be better, more likely the differences between the two approaches

make them more suitable to slightly different situations or questions, but the reader is afforded neither the tools nor the facts with which to judge.

More contentious applications such as species co-occurrence are covered in a rather incomplete manner. A reader should beware: such topics do not yet lend themselves to unbiased accounts, especially when presented anecdotally rather than in an analytical framework. The biases of Gotelli and Graves differ from mine.

TOM PHILIPPI, *Savannah River Ecology Laboratory Drawer E Aiken, SC 29802* tomp@srel.edu

NEWS OF BIOLOGY IN THE SOUTHEAST

Jon R. Fortman-News Editor
Division of Science and Math
Mississippi University for Women
Columbus, MS 39701

ABOUT PEOPLE AND PLACES

FLORIDA

U. S. Geological Survey. Dr. Russell J. Hall has been named Director of the U.S.G.S. Florida Caribbean Science Center, a biological research facility headquartered in Gainesville, Florida. Dr. Hall will be responsible for the overall administration of the science center and several field stations, including the Sirenia Project in Gainesville.

GEORGIA

Savannah River Ecology Laboratory, The University of Georgia. A new 500-page publication called "Conserving Biodiversity on Military Lands: A Handbook for Natural Resource Managers" is now available for the U.S. Department of Defense. The publication is due in part to the efforts of Dr. Gary Meffe, a senior research ecologist with the Laboratory, who wrote the book with Michele Leslie, Jeffrey Hardesty and Diane Adams, all with The Nature Conservancy. It is a resource tool, a handbook to help managers follow the experiences of others and to incorporate the latest scientific information from the field of conservation biology. The book developed after Dr. Meffe and his colleagues discovered that they and officials from the U.S.D.D. all saw the need for a military land management guidebook. The U.S. Military has 25 million acres of land entrusted to its care. Dr. Meffe is also the senior author of "Principles of Conservation Biology," which is the nation's most widely used college textbook on the subject. To obtain a copy of the handbook write to: Office of Deputy Under Secretary of Defense, (Environmental Security) (Conservation), 3400 Defense Pentagon, Washington, D.C. 20301-3400. Researchers at the Savannah River Ecology Lab took part in a worldwide conference on amphibian declines held exclusively on the World Wide Web. This three-month-long scientific conference was sponsored by the U.S. Geological Survey Biological Resources Division at the Patuxent Wildlife Research Center in Laurel, MD. Dr. Philip Dixon and Dr. Joseph Pechmann submitted their paper titled "Testing for No Trend" to the North American Amphibian Monitoring Program, which was held

in cyberspace. *Sam Droege* of the U.S. Geological Survey directed the conference, which was the first scientific conference to be held totally on the WWW.

MISSISSIPPI

Mississippi State University, Department of Biological Sciences. Dr. Jerome A. Jackson was inducted as a new Fellow of the American Association for the Advancement of Science at their annual meeting in Seattle. He was honored for his "work on endangered woodpeckers and species of forest and barrier island ecosystems, for service as a science editor, and for interpretation of science to the public."

Delta State University, Department of Biological Science. Dr. Sherri L. DeFauw was chosen in June as an Associate Professor of Biology to replace *Liz Peeler*. Dr. DeFauw comes from McPherson College in Kansas. Her Ph.D. is from Wayne State University. Her primary research interests include salamander systematics, behavior, ecology and evolution; physiological and behavioral ecology of vertebrates, and Perno-Triassic and Pleistocene herpetofaunal assemblages. She will be teaching Principles of Biology, and Vertebrate Embryology. She will offer a new course in field herpetology in the future.

NORTH CAROLINA

Appalachian State University, Department of Biology. Dr. Ray Williams joins the faculty as an entomologist. Dr. Williams received his Ph.D. from *North Carolina State University* and has held a postdoctoral position at *Oak Ridge National Laboratory*. Dr. Kelly Steele has taken a position at California State University at Hayward. Dr. Steele has been at Appalachian State University for eight years. Dr. Bill Barber Received the Outstanding Teacher of the year in the College of Education. Dr. Matt Rowe was inducted into the Academy of Outstanding Teachers in the College of Arts and Sciences. Dr. Rowe was also the thesis adviser to Ms. Dana Tamashiro, who was awarded the "Best Thesis of the Year" for the University for 1996-1997 for her thesis: "Genetic and Morphological Variation in Northern Saw-whet Owl Populations in Eastern North America."

East Carolina University, Department of Biology. The Department sponsored a series of Distinguished Lectures in the Sciences funded by the Burroughs Wellcome Foundation on three perspectives on Harvesting the Ocean's Resources in the Twenty-first Century. Dr. Daniel Baird, Head of the Department of Zoology from the University of Port Elizabeth, South Africa, covered "Global Fishing Beyond 2000: lessons From the Past." Dr. David M. Manyak, President and Chief Executive Officer of the Biotechnology Firm Oceanix Biosciences Corporation, Hanover, Maryland, spoke on "Unlocking Marine Microbial Diversity: Implications for Drug Discovery and Sourcing New Products from the Sea." The keynote lecture, "Marine Biotechnology: The Potential Realized for Wise Harvesting and Management of the World Oceans," was given by Dr. Rita R. Colwell, President of the *University of Maryland Biotechnology Institute*. Also, a panel of ECU scientists; namely, Dr. Mark Brinson, Dr. Margie Gallaher, Dr. Paul Hager, Dr. Tom McConnell, and Dr. Steve F. Norton led a discussion session on Harvesting the Ocean's Resources. Previously, the Department of Biology with the Department of Physics sponsored the third Howell Science Lecture, Ethics in Research, by Professor Adil E. Shamoo, Editor in Chief of the Journal of Accountability in Research. Drs. Mark Brinson and Richard Rheinhardt received a \$170,000 US Environmental Protection Agency grant for HGM-based Reference Wetland Studies and Training. Additionally, Dr. Richard Rheinhardt received a \$12,066 National Park Service

grant to study "Impact of Water withdrawals on the Vegetation of Dune and Swale communities of Cape Hatteras National Seashore." The search for the department chair is ongoing since the first attempt was unsuccessful. *Dr. Charles Bland* has agreed to remain as chairman until the position is filled.

Pfeiffer University, Department of Biology. *Dr. Steve Dial* was the recipient of an "exemplary teaching" award from the Board of Higher Education of the United Methodist Church. Pfeiffer is affiliated with the church.

Barton College, Department of Biological and Physical Sciences. *Dr. Philip D. Witherington*, Professor of Biology, has retired after thirty years of distinguished teaching and as Chair for the past six years. *Dr. Thomas H. Brugh*, Professor of Biology has been appointed as Chair.

SOUTH CAROLINA

Lander University, Division of Biological and Physical Sciences. The University has initiated a new Master of Arts in Teaching in Science Degree. It is designed for individuals wishing to teach at the secondary level. An individual with a degree in Biology, Chemistry, and Physics may qualify. The program is offered over two summers and an academic year. Students completing the degree will be able to teach chemistry, biology, or earth-space science at the secondary level. Contact: *Dr. David Slimmer*, Division of Biological and Physical Science, Lander University, Greenwood, SC 29649. A new science complex of 124,000 sq. ft. will open in the Spring of 1997 to house biology, chemistry, physics, and math and computer science.

MUSEUMS AND BOTANICAL GARDENS

ALABAMA

Anniston Museum of Natural History. The 1997 Garden Lecture Series will feature Jan Midgley, "native plants of the Southeast"; *Ashby Angell*, "Herb Use in the Garden and Home", and *Jason and Shelly Powell*, "Incorporating Roses into the Landscape." The Board of the Museum appointed *Ellen L. Donovan* to the position of Museum director. She comes from the Historical Society of Palm Beach County in Palm Beach, Florida, and is also an independent management consultant for non-profit organizations. She has an extensive background in the museum field, and successfully wrote grants in Palm Beach for over a half million dollars.

FLORIDA

Marie Selby Botanical Gardens, Sarasota, Florida. Orchid Conservation 97 was held in June, 1997. The international conference brought together research scientists, writers, collectors, and environmental conservationists interested in conservation and ecological issues of global importance. Public events for the current year include: Orchid Illustration - A contrast in Styles (July 1 - Aug. 8), Summer Plant Fair (July 19), The Plant World 19th Century Botanical Art (Aug. 15 - Sept.28), Horticultural Therapy Association Conference (Sept. 27), North American Wildflowers I. Botanical Art (Nov. 1 - 23.)

MISSISSIPPI

Mississippi Museum of Natural Science, Jackson. Brian Pancher has recently joined the staff as the Natural Areas Registry Coordinator and Natural Heritage Database Manager. He will maintain Registry related files in the Biological and Conservation Database in support of the Natural Areas Registry Program as well as other private and governmental conservation efforts. He will also develop and implement natural area management plans on registered Natural Areas, and review environmental impact statements, environmental assessments, and permit requests.

ERRATUM

The article in the January 1997 issue of the ASB Bulletin concerning the retirement of *Dr. Branley Branson* of *Eastern Kentucky University* should have read as follows: *Eastern Kentucky University, Department of Biological Sciences.* Dr. Branley Branson, ichthyologist and natural historian, has retired after 31 years of service at EKU. On April 19, Dr. Branson was honored at a banquet hosted by colleagues, former students and friends. The department's zoological museum collection has been designated as the Branley A. Branson Museum of Zoology. The Museum contains particularly significant collections of fishes, mollusks and crayfishes, many of them collected by Dr. Branson, and is regularly consulted by specialists. Dr. Branson also was instrumental in starting the department's graduate program.



BETA BETA BETA ABSTRACTS

POSTERS

KOWALCZYK, TANYA L. Winthrop University-Interactions between deBrazza's monkeys (*Cercopithecus neglectus*) and black-and-white colobus monkeys (*Colobus guereza*) in Kisere Forest, Kenya.

Although many Old and New World primate species form interspecific associations, studies of deBrazza's monkeys (*Cercopithecus neglectus*) in Western Africa did not find associations with any other primate species. However, observations carried out in Kisere Forest, Kenya, indicate that deBrazza's living in Eastern Africa may form associations with black-and-white colobus monkeys (*Colobus guereza*). During a month-long field study in Kenya, we observed deBrazza's monkeys living along the edge of a river in Kisere Forest. We estimated group spread, distance to the nearest black-and-white colobus troop, and any interactions that took place between the two species. On several occasions, we witnessed members of the two species within meters of one another, sometimes even feeding in the same tree. Based on these field observations and current literature concerning interspecific associations, we propose that deBrazza's monkeys may form interspecific associations with black-and-white colobus monkeys in Kisere Forest, Kenya. We also discuss here whether these associations are based on shared predator detection or enhanced feeding efficiency.

BUTLER, JENNIFER R. Winthrop University, Rock Hill, SC 29733 - Comparative probing behavior of leaffooted bugs (Hemiptera: Coreidae) and brown stink bugs (Hemiptera: Pentatomidae) on tomato.

Green cherry tomatoes were exposed to feeding by leaffooted bugs, *Leptoglossus phyllopus*, and brown stink bugs, *Euschistus servus*. Stylet sheath deposits and the surrounding damaged plant tissue were stained with safranin. Effects of gender and species on probing frequency, occurrence of damage and diameter of damaged areas were determined.

THIELEN, THOMAS E. Winthrop University, Rock Hill, SC 29733 - Scanning confocal laser microscope detection of gut musculature in the free-living flatworm *Stenostomum tenuicaudatum*.

Specimens of *Stenostomum tenuicaudatum* (Turbellaria: Catenulida) were observed under confocal laser scanning microscope in search of muscular tissues associated with the gastrodermis. The specimens were determined to have a very definite network of loosely interwoven longitudinal and circular muscle fibers around the gut, uniformly spaced from 2-10 µm apart. The presence of this musculature directly supports the spiralian theory of lower metazoan evolution, suggesting that the acelomate condition present in the lower Platyhelminthes is secondarily derived from a coelomate ancestor, perhaps through neoteny.

CAPRARO, GERALD A. Dept. of Biology, Catawba College, Salisbury, NC 28144 - The dynamics of purring in the cat *Felis domestica*.

It is a well-known fact that cats purr. However, it is an enigma to most people as to how purring occurs. While the larynx has been shown to produce purring vibrations, the role of the diaphragm is unclear. The purpose of this study was to observe sound vibrations, body surface vibrations at the position of the diaphragm and larynx, and breathing patterns in order to determine the relationship of air movement and vibration to sound production. Surface recordings taken at the larynx and diaphragm show different vibration frequencies and patterns which suggest that the diaphragm functions with the larynx to produce purring vibrations.

ALBRIGHT, WENDY. Dept. of Biology, Catawba College, Salisbury, NC 28144 -

Infrared thermography of regional heterothermy due to sports injury.

Thermographic imaging is a procedure used to evaluate certain conditions such as circulation problems, inflammation and possible tumors. Thermography entails the use of an infrared sensor which perceives the presence of emitted heat from the area of focus and projects a heat profile image onto a monitor. This image is then capable of being recorded onto videotape for further analysis. This research involved the use of infrared images to record and analyze joint injuries sustained by athletes at Catawba College. Several types of injuries were examined such as torn ligaments, fractures, surgically implanted pins, and anterior cruciate ligament reconstruction. By using a control, such as the opposite non-injured joint (i.e. knee), there was a quantifiable increase in heat emission from the injured area. This research advanced the possibility of using thermographic imaging to isolate the site of injury. The results of this research also demonstrated potential for predicting the reoccurrence of injury and the level of healing after a sports injury.

DISTRICT I

VALORAS, DANIELLE. Dept. of Biology, Guilford College, Greensboro, NC 27410 - Isolation and Identification of Bacteria Responsible for a Recalcitrant Paw Infection in a Domestic Cat.

The cause of a recalcitrant paw infection in a domestic cat was investigated. Two morphologically distinct bacteria, a Gram negative rod, and a Gram positive coccus, were isolated from the pus-like exudate. Using standard staining and biochemical tests the Gram negative rod was identified as *Citrobacter freundii* and the Gram positive coccus as *Staphylococcus aureus*. Antibiotic sensitivity testing suggested that an extended course of colistin combined with amoxicillin would be most likely to control the infection.

BRYAN JR., JOHN F. The Citadel - The response of *Aedes albopictus*, the tiger mosquito, to the *Aedes taeniorhynchus*, the black marsh mosquito, oviposition trap.

An oviposition trap developed for *Aedes taeniorhynchus* initiated a positive response in *Aedes albopictus*. The primary attractant is a towel contaminated with microorganisms. Oviposition or egg laying increased by submerging a part of the towel under water.

BECK, TIMOTHY S., BETSY L. FAJEN, AND WILLIAM S. IRBY. Georgia Southern University Bloodmeal sources of *Culex erraticus*, a suspected vector of eastern equine encephalitis virus.

We wanted to determine the feeding habits of *Culex erraticus* in southeastern Georgia to compare them to previous studies conducted in North Carolina, and provide further evidence that this widespread mosquito may be involved in the ecology of eastern equine encephalitis (EEE). *Culex erraticus* and other mosquito species were collected by vacuum aspiration while resting beneath bridges in Bulloch County, Georgia. All mosquitoes collected were identified to species and separated by abdominal condition (unfed, blood-fed, or gravid). Blood-fed specimens were used to determine the vertebrate hosts on which the mosquitoes fed. Bloodmeal proteins were identified using host-specific antisera in an enzyme-linked immunosorbent assay (ELISA). Antisera to representative vertebrates likely to be encountered in Bulloch County, Georgia were used in the indirect ELISA, including antisera to various mammals, birds, reptiles, and amphibians. Patterns of host-feeding were compared to those of previous studies in North Carolina, in which *Culex erraticus* was demonstrated to feed on a variety of hosts, including mammals, birds, reptiles and amphibians. Such a feeding pattern suggests that *Culex erraticus* may be involved in the epizootiological and epidemiological transmission of EEE virus.

Gerald Gracia, Hana Haluhec, Antonio Baines, Mark Nelson, and D.L. Earnest
Effects of Selenium on The Induction and Growth Characteristics of Aberrant Crypt Foci In Rat Colon

The following research was conducted at The University of Arizona to examine and compare the effects of supplemental dietary L-seleno methionine to ursodeoxycholic acid, a known chemopreventive agent, in the azoxymethane (AOM) model of experimental colonic carcinogenesis. Male Fischer 344 rats were utilized in these experiments. All animals were fed a basic diet (AIN 76) supplemented with 1 ppm L-seleno methionine, 2ppm L-seleno methionine, or 0.4% ursodeoxycholic acid (UDCA). Rats were given s.c. injections once a week for 2 weeks with AOM (15mg/kg body wt/week). One group of animals was given the carcinogen 2 weeks prior to dietary treatment(pre), while another group received the treatment 2 weeks after the dietary treatment (post). After sacrifice, their colons were removed, fixed, stained with methylene blue, and examined macroscopically and microscopically for the presence of aberrant crypts (ACF).

When compared to the control group, a increase in the amount of aberrant crypt foci containing more than one aberrant crypt was evident in the UDCA (0.4%). The addition of L-seleno methionine(1ppm) suppressed the enhancement of tumor promotion (aberrant crypt formation). Higher doses of L-seleno methionine(2ppm) significantly reduced the incidence of aberrant crypts. Moreover, cancer chemopreventive effects of L-seleno methionine(2ppm) exceeded that of dietary UDCA. Our results will be the protocol for a larger and more in-depth study of the chemopreventive effects of supplemental dietary L-seleno methionine.

VEDEIKIS, ERICA D. Dept. of Biology, Catawba College, Salisbury, NC 28144 -The effects of cytoskeleton inhibitors on the dynamics of *Physarum polycephalum* shuttle streaming.

The plasmodial stage of the slime mold *Physarum polycephalum* exhibits a synchronous form of cytoplasmic movement called shuttle streaming. In shuttle streaming, the cytoplasm and organelles move as the result of a pressure induced flow of endoplasm (sol) caused by the contraction of the ectoplasm (gel). Shuttle streaming displays a reversal of the direction of cytoplasmic flow which can last several seconds to several minutes. Until recently, this streaming was thought to be periodic, but Coggin and Pazun (*Protoplasma* 194:243, 1996) demonstrated that the oscillator in *Physarum* is neither chaotic nor periodic, but complex. This complex behavior is probably due to interaction between components of the cell motility system. To test this idea, four inhibitors were used to affect the cell motility system. They were cytochalasin B, latrunculin B, phalloidin, and thapsigargin. Cytochalasin B and latrunculin B both inhibit actin polymerization. Conversely, phalloidin inhibits actin depolymerization. Thapsigargin is a Ca^{++} -sequestering ATPase inhibitor which interferes in actin-myosin reactions in the plasmodium. These inhibitors were added to the agar medium on which the *Physarum* were cultured. Time series data on shuttle streaming reversals were collected. Analysis of these data showed changes in the dynamics of shuttle streaming in *Physarum* were related to the state of the cytoskeleton.

Hochel, Robin, Tom Kost, Caroline Lee, Cosette Serabjit-Singh, and Steve Wring. Glaxo Wellcome Inc. - Characterization Of the Recombinant Enzyme Cytochrome P-450 2E1 And Its Utility For Drug Metabolism Studies

In vitro models of drug metabolism are important in order to study and select metabolically stable drugs and predict their routes of metabolism in humans. The ability to successfully generate recombinant enzymes has many benefits. The conditions needed to generate recombinant cytochrome P-450 2E1 (CYP2E1) and the possibility of its use in drug metabolism studies were examined. Several batches of CYP2E1 were prepared (with slightly varied conditions) by coexpressing them with NADPH cytochrome P-450 reductase in insect cells by using a recombinant baculovirus. Activity of the recombinant CYP2E1 microsomes were then measured by two different assay methods. The batch of CYP2E1 with highest activity was determined (allowing the optimum conditions for expressing the recombinant enzyme to be found) and characterized (activity levels, protein concentrations, and kinetics were measured). It was also found that the recombinant CYP2E1, showing its use as a model drug metabolism studies was feasible.

CONNOLLY, MICHAEL S. Armstrong Atlantic State University, Savannah, Ga. 31419
Influence of salinity changes on oxygen consumption by the grass shrimp *Palaemonetes pugio*.

This investigation examined the effects of salinity on the rates of oxygen consumption by the grass shrimp *Palaemonetes pugio*. These shrimp abound in estuaries along the North Atlantic coast where salinity

fluctuations are routine events, which in turn affect their metabolic rate. Medium-sized shrimp individuals were randomly subjected to four different salinity conditions (5, 15, 25, 35 ppt) and their rates of oxygen consumption measured at 22°C over 3-h periods. Significant correlations of salinity with oxygen consumption rate were documented in this study. Minimum rate of oxygen consumption per mg. dry weight occurred at 15 and 25 ppt. At salinities of 5 and 35 ppt, metabolic rates increased significantly. During the 3-h trials, oxygen uptake at all test salinities were almost always minimum during the last hour suggesting that *P. pugio* is an oxyconformer; its oxygen uptake decreased as oxygen tension declined.

CLARKSON, FRANCIS A. Erskine College - Is RTI-55 a Cure for Cocaine Abuse?

RTI-55 is a cocaine analogue that differs in structure only slightly from that of cocaine. The two drugs have identical binding sites to the mammalian dopamine transporter, but RTI-55 binds more strongly to the transporter than does cocaine. It has been proposed that the addictive nature of cocaine stems from its tendency to cause intrasynaptic dopamine levels to rise dramatically, secondary to dopamine transporter blockage. Research has suggested that only a certain type of intrasynaptic dopamine increase—namely a quick and strong increase—causes neurological effects linked to addiction. It is theorized that RTI-55 could be used as a competitive antagonist to cocaine, eventually finding efficacy as a treatment for cocaine abuse. This theory is based on the proposition that saturation of dopamine transporters by RTI-55 would competitively exclude cocaine and thus nullify cocaine's normally seen effects. This project sought to examine, using the technique of *in vitro* microdialysis, whether sequential dosing of RTI-55 causes significant increases in intrasynaptic dopamine levels. The data produced shows that indeed sequential dosing of the cocaine analogue does produce quick, strong increases in intrasynaptic dopamine after each dose; this conclusion suggests RTI-55 as ineffective in treating cocaine abuse.

RODILLO, ELLEN E. Erskine College - Psychoactive Drugs: Functional Mapping in the Rat Brain Using Fos Immunohistochemistry as a Dynamic Marker of Brain Activity

Immunohistochemical investigations were conducted on the brains of rats that had received an external stimulation via an intraperitoneal injection. The treatment administered was either a saline solution or a psychoactive drug. The drugs used in this experiment, LSD and cocaine, were found to cause the induction of the *fos* immediate early gene to express the *Fos* protein. Specific brain regions contained *Fos* after the administration of the treatments. With the knowledge that *Fos* is transiently expressed with brain site and stimulus specificity, it is possible to conclude that the brain sites containing this protein are activated by the stimulus used to elicit this response. *Fos* immunohistochemistry allows for functional mapping in the rat brain. Thus, *Fos* is expressed in brain areas which are specifically involved in response to the stimulus administered. The detection of brain activity in these regions can then be correlated with the function of those areas.

KIEHL, ALLISON H., AND DAVID J. ANDERSON. Wake Forest University - A Phylogenetic Analysis of the Evolution of Sexual Size Dimorphism in Birds.

There are many hypotheses concerning the evolution of sexual size dimorphism in birds. Since males are larger in most species, the taxa that are "female larger" have been investigated frequently. In this study, we analyzed the variation in SSD across the entire class of birds (Aves), rather than simply concentrating only on female larger species that are said to exhibit reverse size dimorphism (RSD). We speculate that females in more violently foraging taxa would have been subject to selection pressures to more effectively cushion their developing eggs against impact sustained during violent foraging. This could have been accomplished by increasing body mass. We predicted that as a taxon's foraging became more violent over evolutionary time, the females became larger in relation to the males in the developing taxa. Males of the taxa in question would not have been affected by the selection factor acting on the females, therefore, the taxa would have become more female larger than the less violently foraging relative taxa which descended from the same ancestor. In our phylogenetic analysis, using the phylogeny proposed by Sibley and Ahlquist, we found that as taxons became more violent in foraging, they also evolved to become more female larger. We conclude that the evolutionary increase in relative female body mass was an adaptive response to more violent foraging. Extra cushioning was required by females (and not males) in order to protect developing eggs.

SHULIS, AMBER M AND MELISSA SPRENNE Erskine College-*Agrobacterium tumefaciens*-mediated transformation of *Camellia japonica* and *Camellia sasanqua*

Camellia species are susceptible to the camellia blossom blight fungus, *Sclerotinia camelliae*, which causes the blossom to turn brown and fall from the plant. In order to begin investigating possibilities for genetic engineering of camellias, protocols were previously developed for the tissue culture of *Camellia japonica* and *Camellia sasanqua*, and adequate amounts of callus have been provided from several tissue sources. In addition, recent evidence of organogenesis has been demonstrated for callus originating from *C. japonica* petal tissue grown on Anderson's Rhododendron medium containing 2mg/L of kinetin and 0.5mg/L of 2,4-D. *Agrobacterium tumefaciens*-mediated transformation is currently the most successful method for transformation of dicotyledons; however, no direct evidence of camellia infection has been found. In order to determine whether the use of *A. tumefaciens* is feasible, studies utilizing *A. tumefaciens* At699 containing a gusA-intron gene under the control of the CaMV 35S promoter have been initiated.

In vivo and *in vitro* Regulation of *emrR* in *Salmonella typhimurium*
Ginger M. Blalock

Salmonella typhimurium is the causative agent of typhoid fever in mice. Genes which are induced in *S. typhimurium* specifically during the infection of host mice are of interest because these genes typically play a role in virulence of the bacteria. One of the operons which was identified to be turned on in the host was the *emr* operon. This operon is a homologue to *emr RAB* in *Escherichia coli*.

The *emr R* gene in *E. coli* is a negative regulator of the downstream *emr A* gene which confers multidrug resistance to the cell. The *emr* operon in *S. typhimurium* also confers multidrug resistance to the cell, but the regulation of this operon has not been fully characterized.

The *emr R* gene is not induced *in vitro* in *S. typhimurium* by nalidixic acid, salicylic acid, or (m)-chloromethoxycarbonylcyanide (CCCP). This indicates a difference between the *emr* operon in *E. coli* and the *emr* operon in *S. typhimurium*. For this reason, the gene will be tested for induction *in vivo*. The *emr R* gene is expected to be induced *in vivo* because the gene was originally recovered from the host. Tissue culture will also be used to determine whether the gene is induced in macrophages.

ELLIS, JANA C. Erskine College, Due West, SC 29639 - A study of Eastern Box Turtles in a residential island habitat.

A population of Eastern box turtles, *Terrapene carolina carolina*, was tracked using radiotelemetry in a residential island habitat near Mauldin, S C. The turtles were located four or five times a week during the summer and approximately three times a week in the fall and spring. The 1996 home ranges were calculated using a minimum convex polygon method, and foraging and hibernation sites were identified. These data were used to make sexual and seasonal comparisons in home ranges and behavior.

PAYSEN, ERIC S. Winthrop University-The response of leaffooted bug *Leptoglossus phyllopus*, (Hemiptera, Heteroptera: Coreidae) eggs to constant temperatures.

Leptoglossus phyllopus eggs were experimentally placed and observed in Charleston, South Carolina. High parasite emergence from these eggs suggested the wasps as a biocontrol agent. A lack of data on temperature dependent host egg development led to this study. A maximum, mean egg development rate of 5.2 days and a minimum mean percent survival of 8.4% were found at 35 C. A minimum mean egg development rate of 19.4 days, and a maximum mean percent survival of 97.1% were found at 20 C. The data combined with existing data on *Gryon pennsylvanicum*(G.) suggests that their temperature dependent biologies are compatible.

CHAVIS, KENYON M.¹, DEREK ZELMER¹, AND ERIC WETZEL¹. ¹Dept. Biology, Wake Forest University and ²Dept. Biology, Wabash College - The effects of age and temperature on the infectivity of *Halipegus occidualis* to its ostracod second intermediate host.

It has been suggested that the decrease in infectivity of the cercariae of *Halipegus occidualis* is due to the depletion of glycogen energy stores with time. If this is the case, then environmental temperature should also have an effect on infectivity because of its relationship with metabolic rate with infectivity being lower at higher temperatures. *Halipegus occidualis* cercariae were placed in incubators at 4 C, 16 C, and 30 C for regular intervals up to 25 days and exposed to uninfected ostracods to determine the experimental effects of age and temperature. The amount of infectivity of the cercariae decreased as the age and temperature were increased.

BADGETT, C. JAN AND ROSANNE SPOLSKI. Wake Forest University - Functional role of a lymphoid-specific transcription factor which interacts with an E box within the T cell receptor gamma gene enhancer.

Members of the helix-loop-helix (HLH) family of transcription factors are involved in regulating tissue-specific transcription in many lineages. Some HLH proteins function as central regulators of cell type determination. All HLH proteins bind to an E-box core motif (CANNTG) within regulatory elements. Sequence analysis of the T cell-specific enhancer located upstream of the T cell receptor gamma gene revealed the presence of multiple E box core motifs within this enhancer. The specific aims of this project were to determine whether nuclear proteins interact with the E boxes within the T cell receptor enhancer and to determine whether these E boxes play a functional role in the activity of this enhancer in T cells. Gel mobility shift assays of DNA binding proteins in a panel of staged T cell and non-T cell lines and also in various lymphoid and non-lymphoid organs revealed the presence of specific complexes in the T cell lines and lymphoid organs but not in the non-lymphoid cell lines and organs. Analysis of the developmental appearance of these protein complexes suggested that they appear early in fetal thymic development. Site-directed mutagenesis of these E boxes within the enhancer was used to construct mutant enhancers which could be tested for functional activity in CAT reporter transient transfection experiments. These transfection experiments showed reduced enhancer activity of the E box mutants compared to the wild-type enhancer. These results suggest that a lymphoid-specific transcription factor interacts with the T cell receptor gamma enhancer and may play a role in the developmental activation of this regulatory region.

GEVERD, DAWN A. Department of Biology, Catawba College, Salisbury NC 28144 - Cellular differentiation in yeast dimorphism.

Cellular differentiation is one of the fundamental problems in biology. One example of cellular differentiation is dimorphism in fungi. Dimorphic fungi spend part of the life cycle as a single cell yeast and part of the life cycle as a multicellular filamentous hypha. *Saccharomyces cerevisiae* is a budding yeast that has two types of cell division, axial and bipolar. On complete medium *S. cerevisiae* undergoes axial or bipolar division producing round colonies but on nitrogen limited medium the division is unipolar. Unipolar division results in growth of pseudohyphae and irregular shaped colonies. The cells of *S. cerevisiae* when grown on the nitrogen depleted medium are much longer and wider than those grown on complete medium and form elongated chains in one direction. *Schizosaccharomyces pombe* is fission yeast but also produces pseudohyphae when grown on a nitrogen limited medium. When *Schiz. pombe* is grown on complete medium the cell divides into two equal size cells that separate after division. On nitrogen limited medium, *Schiz. pombe* produces very long cells that do not separate after division but continue to divide in a unipolar manner. (Yarborough Research Grant).

DISTRICT II

Engelke, Debra M. Loyola University--Comparison of Microscopy and PCR in Detection of *Trypanosoma cruzi* in vector samples.

Chagas' Disease is a leading cause of heart disease and mortality in Latin America. The etiological agent, the protozoan parasite *Trypanosoma cruzi*, is transmitted by Reduviid bugs. Previously, *T. cruzi* has been detected

in vectors by microscopic examination of the vector feces. Recently, investigators have used the polymerase chain reaction (PCR) on vector fecal samples which have shown to be an effective means of detection. The relative sensitivity of microscopy and PCR was tested on two vector populations in Guatemala and different parts of the bug were tested to determine which part of the bug contained the parasite. One hundred and thirty *Triatoma dimidiata* and *Rhodnius prolixus* bugs were collected and dissected. From each vector, samples were taken from the salivary glands, rectal gland, stomach, and intestines, and analyzed by microscopy and PCR. Our results indicate that PCR is a slightly more sensitive method of detection than microscopy in *Triatoma dimidiata*, and that analysis of the rectal sample was sufficient to determine infection in the bug. In *Rhodnius prolixus*, PCR was nearly twice as sensitive as microscopy, and analysis of body parts in addition to the rectal gland was necessary to determine infection of *T. cruzi*. Co-infection with *Trypanosoma rangeli*, a nonpathogenic parasite that appears identical to *T. cruzi* by microscopy, was also evident by the PCR. More than fifty percent of the bugs collected in Prensa were infected with *T. cruzi*, the highest rate of infection out of the four villages tested in Guatemala. Apantes, Prensa, El Jute, and Amatillo.

BONE, SAMANTHA J. and ROGER SAUTERER. Jacksonville State University-
An electrophoretic study of two geographically isolated populations of
Elimia acutocarinata.

Two populations of *Elimia acutocarinata* that have been geographically isolated from one another for seventy five years were discovered in Georgia. They exhibit two distinct breeding patterns and do not appear to recognize one another reproductively (Bailey 1992). It is hypothesized that speciation has occurred between these two populations. This hypothesis will be tested using Iso-electric focusing in coordination with enzyme assays to establish differences in protein pattern. Preliminary results indicate differences between the populations both in overall IEF protein patterns and in acid phosphatase isozymes.

VARGAS, JUAN C. Loyola University New Orleans-In vitro cultivation of the mosquito stages of the *Plasmodium* parasite.

For many years, the role of the mosquito in sporogonic development of the *Plasmodium* parasite has largely been ignored. As a result, no cultivation method has been developed that would efficiently support the parasite throughout these stages. In this study, the transformation efficiencies of *Plasmodium gallinaceum* (8A strain) parasites cultivated in basic medium were compared to the transformation efficiencies of those cultivated in basic medium to which supplements (amino acids, carbohydrates, and minerals) or insect cell lines (ASE1A, ATC-10, C6/36, MOS-55, MAT, and AP-61) were added. A minimal difference was observed between the cultures in the basic medium and the cultures supplemented with amino acids, carbohydrates, or minerals. However, the cultures containing the insect cell lines exhibited an increase in the parasite transformation rates. Further observations demonstrated that the increased transformation rates were mainly stimulated by the parasites' interaction with the cells and not because of factors released by the cells. Future studies are needed in order to identify the specific parasite-cell interactions. The identification of such interactions is essential for the development of a transmission-blocking vaccine at the level of the mosquito.

ZIMLICH, MICHAEL A. AND STEPHEN C. LANDERS. Dept. of Biology, Troy State University, Troy, AL 36082-Morphological variants of apostome ciliated protozoa from
Dauphin Island, Alabama.

Apostome ciliates are symbionts with complex life cycles that involve specific feeding, divisional, migratory, and phoretic stages. Apostome species are differentiated by the ciliature of the feeding stage (trophont). In this study the apostome *Hyalophysa chattoni*, an ectocommensal on the grass shrimp *Palaemonetes pugio*, is examined and a variant trophont stage is described. During metamorphosis to form the normal ciliature of the trophont, Falciform Field 9 (FF9) in the phoront disperses to create an anterior ventral field (AVF) of cilia. The posterior end of the field remains intact as a short kinety (a) located near the cytostome. In apostomes collected from coastal Alabama, a variant morphology occurs in which FF9 does not fully disperse and the AVF contains more kinetosomes than usual. Kinety "a" was not observed in variant forms, which were dominant (75%). The distinct ciliature typically would distinguish this form as a new species, but we do not consider it a new species because the cell transforms to a normal morphology after feeding.

VOLTAGE AND LENGTH TENSION CHARACTERISTICS OF A PREGNANT AND NONPREGNANT "UTERI" IN *THAMNOPHIS RADIX*.

*Lane M. Smiley, Millsaps College, Jackson, MS 39210

Do circular and/or longitudinal layers of uterine smooth muscle of pregnant and nonpregnant snakes exhibit a voltage tension (VT) and length tension (LT) curves similar to mammalian striated muscle? VT and LT data were gathered on Pregnant (n=4) and nonpregnant (n=4) snakes (4 replicates/snake). Uterine samples were then stimulated at the suprathreshold voltage (50v). As lengths in pregnant snakes increased from 0 through 20%, contractions increased proportionally, and then remained approximately constant (40 g/g SEM $\pm$ 5) above 20% and through 70%, then diminished as lengths increased to 150%. Longitudinal muscle exhibited variable contractions from 0 to 20% (43 g/g SEM $\pm$ 4) then gradually diminished at lengths increasing upwards to 150%. The longitudinal muscle LT curves are similar to that of striated muscle, but circular muscle differs. Nonpregnant snakes exhibited similar patterns but ten fold less in magnitude. Both have lengths at which they contract most strongly, but circular layers contract almost equally strongly at a number of lengths. These different LT patterns suggest different functional roles for circular and longitudinal layers. The fact that maximum contraction occur at a particular length suggest researchers must test at particular lengths if they wish to assay smooth muscle under optimal conditions and calls in question the number of chordate muscle studies done where length is not controlled.

POLLARD, PENNY R. And SAUTERER, ROGER A. Jacksonville State University
Synthesis of Heat Shock Proteins and Changes in Protein Patterns During Cryptobiosis of Tardigrades.

We investigated the hypothesis that heat shock proteins are synthesized in large quantity during the transition to the cryptobiotic state in tardigrades in order to protect the tertiary structure of essential proteins during desiccation. Preliminary studies involved analysis by SDS-PAGE and silver staining of equal numbers of cryptobiotic and fully hydrated, living tardigrades. Neither new bands nor significant changes in overall levels of protein bands in the 70 kD region were found, suggesting that cryptobiosis does not involve synthesis of new HSP 70 isoforms or significant increases of other HSP 70s. A second family of heat shock proteins have a molecular weight of about 20 kD. Analysis of high-percentage SDS-PAGE gels reveals occasional but inconsistent changes in levels of bands in the 18 - 20 kD region. More detailed analysis will require immunoblotting with broad-spectrum antibodies directed against various families. We tentatively conclude that cryptobiosis does not involve expression of novel HSP 70s or substantial increases in HSP 70 levels.

MAITRE, MICHELE. Northern Kentucky University--The effect of stromelysin-2 expression by stromal and epithelial cells on the metastatic potential of breast neoplasms.

Many primary neoplasms occur in organs that can be sacrificed surgically such as the breast or colon. Once the neoplastic cells have entered the bloodstream, there is always a chance for metastatic growth which usually arises in a vital organ that cannot be sacrificed such as the liver, lungs, or brain. The matrix metalloproteinase stromelysin-2 has been linked to the increased metastatic potential of neoplasms such as breast cancer. Formalin fixed/paraffin embedded breast cancer tissues from the Wood Hudson Cancer Research Lab in Newport, Kentucky, are being subjected to avidin-biotin immunoperoxidase staining with monospecific antibodies against stromelysin-2 to indicate the presence of stromelysin-2. The presence or absence and degree of stromelysin-2 expression are being compared to the metastatic or non-metastatic outcomes of the patients from whom the tumors were removed. I hypothesize that this research will confirm the relationship between stromelysin-2 expression and the increased risk of metastasis in individuals with breast cancer. I am also examining sites of stromelysin-2 expression in normal breast tissue. This research is currently in progress.

LANG, GENE A. and SEAN P. GRACE. Millsaps College--Generation of Suppressors of the *Aspergillus nidulans* nimX^{cdc2}F223L Mutation.

One of the hallmarks of cancer cells is loss of control of the cell division cycle, leading to uncontrolled cellular division. The objective of this work is to identify genes involved in controlling cell division by generating extragenic suppressor mutations which suppress the temperature sensitive phenotype caused by the *Aspergillus nidulans* nimX^{cdc2}F223L cell cycle mutation. nimX^{cdc2}F223L cells were treated with 4-

nitroquinoline-N-oxide and survivors directly screened for reversion of the mutant phenotype. Of 5,000 temperature-insensitive revertants isolated, 2,020 have been further screened for the presence of an additional phenotype of cold-sensitivity to aid in future cloning of the suppressor genes. Of these, 8 cold-sensitive strains have been isolated, and genetic analysis indicated that 6 contain extragenic suppressor mutations. These strains will be further characterized to determine if any of the suppressor mutations are allelic.

JENKINS, CLINTON N. East Tennessee State University- Tardigrade distribution in South-Central Florida.

Limited studies have been performed on terrestrial tardigrades in Florida. Samples were taken of mosses, lichens, and epiphytes at several locations in South-Central Florida. Tardigrades found in these samples were enumerated and identified. Results suggest that tardigrade species are common in some types of moss, but not in lichens or epiphytes.

WHETSTONE, JOHNATHAN R. Western Kentucky University -Analysis of the *Chlamydomonas reinhardtii* circadian rhythms using radio labeled DNA probes.

Circadian rhythms have been reported for many different organisms, among them *Chlamydomonas reinhardtii*. This unicellular green alga has been used extensively as a model organism and was also analyzed in this study. *Chlamydomonas* has been shown to exhibit a rhythmic pattern of mRNA abundance for several nuclear genes like those coding for chloroplastic CAB II-1 protein, cytosolic beta tubulin, and mitochondrial cytochrome c. The discovery of these rhythmically controlled genes opened the question if many or even all nuclear genes in *Chlamydomonas* show rhythmic expression. In order to investigate this idea, other basic genes are presently evaluated for their expression pattern. The genes tested encode the heat shock protein 80 and a photosynthetic cab-like protein. The method used to measure changes in the amount of mRNA under constant conditions for the chosen genes is northern blot analysis. Preliminary experiments have already shown that cells do have a varied concentration of these mRNAs at different times of the day. Each membrane in our northern blot analysis contained RNA samples extracted from cells under alternating light and dark cycles which corresponded to dawn and dusk, respectively. The blots were probed with radioactively labeled DNA fragments complementary to the genes discussed above. After analyzing the autoradiograms from the northern blots, a difference in the amount of mRNA between dawn and dusk was detected. Further studies will reveal, if these differences can also be detected under constant environmental conditions. A grant received from Western Kentucky University Honors Program is gratefully acknowledged.

MEGAN A. JASKOWIAK. Department of Biological Sciences, Northern Kentucky University, Highland Heights, KY 41099-Diatom deformities in the Little Miami river, Ohio.

The Little Miami river, a medium sized, eutrophic river, flows through five counties in Southwestern Ohio and empties into the Ohio River. This study is part of a large project to study the effects of high phosphorus on the river and its biota. Diatoms were sampled three times during the summer of 1996 at eleven sites along the river's length. The species composition varied significantly between sites and between sampling dates. The only stable site was the farthest station, 62Km from the Ohio River. Results show eutrophication is among several factors affecting the diatom species composition. Deformities in the diatoms were found in three sites closest to the Ohio River in July and then in six sites in September. S.E.M. and Atomic Spectrometry are being used to determine a cause of the deformities. Organic pollutants or heavy metals are suspected.

STRICKER, JULIE B., and CHRIS VIREN. Northern Kentucky University -Vanadyl sulfate: anabolic or anti-beneficial.

Vanadyl sulfate is a product available over the counter as a non-steroidal anabolic agent. It is sold as a mineral supplement and is therefore not regulated as a drug by the FDA. It is touted as an insulin mimetic and has been shown to promote uptake of glucose from the blood into peripheral tissue. However, vanadyl sulfate has not been proven to mimic the muscle-building action of insulin. We investigated the potential anabolic effects of vanadyl sulfate on muscle and its possible side effects. Vanadyl sulfate was administered orally twice daily to

laboratory rats. All three groups received 0.5cc, 10% glucose per treatment. The first experimental group of 16 rats received the dosage recommended by the manufacturer and adjusted for the weight of the average rat; and the second experimental group of 16 rats received three times the recommended dosage. Once a week for six weeks blood glucose levels and animal weights were recorded. At the end of this time, the animals were sacrificed and the right gastrocnemius and pancreas of each animal were removed and hematocrits were taken. A one-way analysis of variance yielded F-scores that showed no significant difference between the experimental groups and the control group.

Love, Cardelia A., Southern University and A&M College, and Louisiana State University, The Ovariectomized Retire Female Breeder Rat as a Model for Postmenopausal Women

The purpose of this project was to confirm accuracy with the National Institute of Science and Technology bovine liver standard and compare the values between the two methods of drying before ashing the standard: 1st=NIST procedures, 2nd method= Human Ecology Laboratory.

It is important to have standardized procedures in laboratory analysis. Samples were blocked by treatment with each ashing. The NIST bovine liver standard was used. The ashing procedure, allowing the HUEC to develop a factor associating the two different drying technique. The experimental procedure involved: 20 samples 5 treatments in a study, 4 samples per treatment with each ashing, 8 samples per treatments in a study, 4 samples per treatment with each ashing, 8 samples per treatment with 2 ashings. The drying procedures were the NIST method of 20-25 degrees Celsius, 0.2 mm Hg for 24 hours versus the HUEC method of 350 degrees Fahrenheit for 1 hour.

This experiment is very important for the analytical procedure in the ovariectomized retired female breeder rat as a model for postmenopausal women. Further testing will be done on the legs, arms, heart, and kidneys of rats.

HERRINGER, JENNY. Northern Kentucky University- Antibacteria properties of ferns at different elevation and soil pH in Ecuador.

The Kirby-Bauer disk diffusion test was used to test the antibacterial properties of fern extracts. Ferns were collected from natural populations growing at different elevations in Ecuador. The habitat, pH and altitude were recorded at each site. Extracts were made by macerating the stipe and frond separately and placing them in ethanol. Disks saturated with the extracts were tested on lawns of *Staphylococcus aureus* and *Escherichia coli*. The zones of inhibition were measured in millimeters. Simple regression analysis revealed a correlation between elevation and soil pH with the size of the zones of inhibition produced by the fern extracts.

SIKES, ELIZABETH M., TORREY O. KNIGHT AND MARCIE L. PARRISH.
Columbus State University--Starch gel electrophoresis of blood enzymes from gopher tortoises (*Gopherus polyphemus*) sampled from populations in southwest Georgia.

The gopher tortoise is a keystone species inhabiting the coastal southeastern United States. Silviculture, agriculture, and urban development have fragmented the habitat resulting in isolated populations. Tortoises in this study were collected from two localities in southwest Georgia. One site included tortoises captured as part of a GA DOT funded relocation project along US Highway 27 between Colquitt and Bainbridge, GA. The second sampling area was the Joseph W. Jones Ecological Research Center, in Baker County, GA. Tortoises were captured using bucket traps. Approximately one cc of blood was drawn from the brachial artery. The plasma was separated by centrifugation or settling and frozen at -80 celsius. Starch gel electrophoresis on blood enzymes was used to determine genetic variation within and between populations of gopher tortoises. Seven gel / electrode buffer systems were used to determine the activity levels of 18 different enzymes. We found seven enzymes to be consistently active on three different gel / electrode buffer systems. No enzymatic variation was found within or between any of the populations. This study will be expanded to include populations from different parts of the gopher tortoise range and more sensitive methodologies will be employed to assess population genetic variation.

PLANT SYSTEMATICS

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IN THIS ISSUE

THE ASB BULLETIN

VOLUME 44, NUMBER 3, JULY 1997

PRESIDENT'S CORNER: A VIEW FROM HERE	155
ASSOCIATION AFFAIRS	157
ASB Officers, Committees and Representatives and <i>ASB Bulletin</i> Staff, (157); Resolution of Appreciation (161); 1997 Research Award Recipients (162); Deaths of ASB Members in 1996 (165); Emeritus Membership (165); Student Support Award Recipients (165); Editor's Report for 1997 (165); Greenville Meeting Wrap- up (165); Treasurer's Report (166).	
CALL FOR PAPERS AND IMPORTANT DEADLINES	169
ANNOUNCEMENTS	170
REVIEWS	171
NEWS OF BIOLOGY IN THE SOUTHEAST	172
BETA BETA BETA ABSTRACTS	176
Cover photo - Robert Parriott, Appalachian State University, Boone, NC	

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October 1997

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44
p. 4
October
1997

In this issue:

- ◆ *FINAL CALL FOR
PAPERS FOR THE 1998
ANNUAL MEETING*
- ◆ *“BLUE” FORM FOR
SUBMITTING ABSTRACTS*
- ◆ *CALL FOR SUBMISSIONS
FOR AWARDS*
- ◆ *CALL FOR NOMINATIONS
FOR OFFICERS OF ASB*

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sbowden@ness.agnesscott.edu; FAX (404)638-5368

Executive Committee Members-at-Large:

1998: Phil Robertson, Dept. of Plant Biol. Southern Illinois University, Carbondale, IL, 62901; (618)453-3236;
probertson@plant.siu.edu

Robert Haynes, Dept. of Biol., University of Alabama, Tuscaloosa, AL 35487; (205)348-1826;
rhaynes@biology.as.ua.edu

1999: Douglas A. Rayner, Dept. Biol., Wofford College, Spartanburg, SC; (864)597-4624; raynerda@wofford.edu
Dwayne Wise, Dept. of Biol. Mississippi State University, Drawer GY, Mississippi State, MS 39762-5759;
(601)325-7579; daw@ra.msstate.edu.

2000 Patricia Cox, Div. of Biol., 301 Hesler Hall, University of Tennessee, Knoxville, TN 37996; (423)974-6225;
pbcox@utkux.utcc.utk.edu

Terry Richardson, Dept. of Biol. UNA Box 5212, University of North Alabama, Florence, AL 35632-0001;
(205)765-4429; trichard@unanov.una.edu

PURPOSE

The purpose of this association shall be to promote the advancement of biology as a science by encouraging research, the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. Members receive the *ASB Bulletin*.

TIME AND PLACE OF FUTURE MEETINGS

1998	April 15-18	Northeast Louisiana University, Monroe, LA
1999	April	University of North Carolina at Wilmington, Wilmington, NC
2000	April	University of Tennessee at Chattanooga, Chattanooga, TN

1997 Meritorious Teaching Award



The 1997 Meritorious Teaching Award was presented to Dr. Rebecca R. Sharitz during the ASB banquet in Greenville, SC, April 18, 1997. This award is sponsored by the Carolina Biological Supply Company and includes a bronze plaque, the letters in support of her nomination, and a check for \$1000.

This year's award recipient, Rebecca Sharitz, is a true southerner, born and raised in Virginia, educated at Roanoke College (BS, 1966) and the University of North Carolina (PhD, 1970), and employed by the University of Georgia's Savannah River Ecology Laboratory since 1972. While conducting a full-time research program, she has also served in administrative roles within SREL and the general scientific community. At SREL, she has been Assistant Director, Acting Director, and Head of the Division of Wetlands Ecology. Rebecca is currently Secretary-General of the International Association of Ecology and has been President of the ASB, Vice-President and Treasurer of the Ecological Society of America. She has also served on several committees of the National Research Council (National Academy of Sciences).

Even with these demands on her time, she has been very actively involved with teaching through graduate student classwork and graduate student supervision. In this capacity, she serves as an excellent role model and mentor for graduate students. A common theme reflected by her students and post-doctoral advisees is her enthusiasm and that she teaches self-reliance, but is always available for help and advice:

"Over the years, I have watched Becky teach others (and me) by example. Her strong work ethic, high professional standards, and respect for all people are all qualities that I hope to imitate in my own career."

"I'll always remember her infectious enthusiasm as she completely disregarded ruining a pair of good shoes while wading in the cypress swamp to introduce me to several *Ludwigia* species."

"Becky employs one or more special mentoring techniques such as cajoling, encouragement, pointed direction, sympathy, humor, an occasional boot when needed, and above all, a clear picture of how each individual can be successful, which she articulates in a direct, no nonsense way."

"Of all her qualities, perhaps the key is her ability to put people at ease. We stand in awe of her, yet we see her as such a down-to-earth person that we think to ourselves, 'We could do what she does, too, if we work as hard.' And to me, the ability to foster that perception is the single most important attribute a great teacher should have."

Many of her present and former technicians testify that Becky creates an environment in the workplace that fosters self-improvement:

"Dr. Sharitz's love of ecology and nature, high professional standards, and supportive role as friend and mentor have had, and will continue to have a profound influence on my life, both personally and professionally. There is no one that I respect and admire more."

"Her leadership and guidance allowed me to learn many new skills and expand my education."

"Her ability to pass along some of this knowledge in many informal discussions, either in her office, the lab, or quite often in the field, was of the utmost importance to me and my professional development."

Rebecca "Becky" Sharitz has had a consistently positive influence on her advisees and the field of ecology for many years. Her unassuming nature, the respect she pays others, and her open-door policy make her approachable to students, technicians, and colleagues alike. She has high expectations for herself and extends those to everyone around her. Her effectiveness as a teacher and mentor is evident from the success of her former advisees.

Her enthusiasm is evident whether she is leading field trips for lay persons, conducting seminars for students, galvanizing a community's interest in its natural resources, wading through the swamp to get that last measurement, or functioning as a leader in the international research community. Becky's enthusiastic involvement in these different areas underscores her deep commitment to her field, and we all marvel at her ability to juggle a million tasks at once. She is an extraordinary role model and well-loved teacher and an excellent choice as this year's ASB Meritorious Teacher.

ASSOCIATION AFFAIRS

CALL FOR PAPERS
THE 58TH ANNUAL MEETING
HOST: NORTHEAST LOUISIANA
UNIVERSITY
MEETING SITE: MONROE, LA
DATE: 15-18 APRIL 1998

Please note the following deadlines which are to be met before our 58th Annual Meeting hosted by Northeast Louisiana University.

- | | |
|-------------------------------------|---|
| 15 November | Titles and abstracts of papers and posters (use blue abstract form). This will be the <i>only</i> call for papers. They must reach the program chairman by this date. |
| 15 November | Nominations for ASB officers and executive committee. |
| 15 November -
2 February | Submissions for research awards. |
| 2 February | Application for student travel awards. |

NOTICE

ASB and the Local Committee wish to encourage greater use of posters as an effective means of presentation. All posters will automatically be entered in a judging for a \$200 prize. Please consider whether your presentation could be given in the form of a poster. Guidelines for size limitations will be given in the January *ASB Bulletin*.

GUIDELINES FOR POSTER SESSION AND ASB POSTER AWARD (\$200)

Poster sessions have been incorporated as a regular means of scientific presentation at the annual ASB meetings. This type of presentation provides a more informal environment that encourages a direct interchange of ideas and discussion between presenter and audience. In order to stimulate greater use of posters as an effective means of presenting research results, ASB awards a \$200 cash prize to the best poster presentation. All posters will automatically be entered in a judging for the Poster Award. Adherence to the following guidelines will help ensure the effectiveness of the poster presentation and consideration for the award.

- (a) Display should fit on a 4' h x 8' w board suitable for thumbtacks or pushpins.
- (b) Posters must be displayed from 10:00 a.m. Thursday through 5:00 p.m. Friday. Authors will be required to be present at specified times during the annual meeting.
- (c) Posters should be carefully planned to maximize clarity and simplicity in conveying information.
- (d) Poster should have a heading including a title, author, and author's institution(s). This heading should be placed at the top in letters no less than **3 cm** high.
- (e) The body of the poster, including text, figure legends and table captions, should be in type no smaller than **18 pt. (3-4 mm)** and *must* be legible from a distance of about 1-2 meters.
- (f) The body should be self-explanatory and should include figures, tables, graphs, maps, or photographs displayed in a well organized, coherent, and easy-to-follow sequence from top to bottom. Each illustration should contain a caption. *Do not over crowd the display.*
- (g) A limited degree of text may be included, but care should be taken not to overwhelm the audience.
- (h) A large, abbreviated version of the abstract should be presented at the top of the poster, but below the heading. A clear listing of specific conclusions should appear at the bottom or end of the presentation.
- (i) In addition to adherence to the above listed guidelines, poster presentations will also be judged using the following specific criteria:
 - (i) overall aesthetics and attractiveness of presentation.
 - (ii) ease of reading from a distance (1-2 meters).
 - (iii) clear and concise organization.
 - (iv) clearly stated hypothesis.
 - (v) soundness of methods for testing hypothesis.
 - (vi) how well conclusions are supported by results

Further inquiries may be directed to the chair of the ASB Poster Award Committee:
Dr. Terry D. Richardson, University of North Alabama, Department of Biology,
UNA Box 5212, Florence, AL 35632-0001, (205) 760-4429, Fax (205) 760-4430,
email: trichard@unanov.una.edu.

1998 ASB MEETING

CALL FOR PAPERS & POSTERS FOR 1998 MEETING

DEADLINE: 15 November 1997

Individuals presenting papers or posters are expected to be members of ASB!

This form, along with the original (blue) and one photocopy of the abstract should be addressed to the Program Chairman, Dr. Frank Pezold, Department of Biology, Northeast Louisiana University, Monroe, LA 71209. Forms must be received no later than **15 November 1997** for the title to appear on the program and the abstract to be published in the April 1998 *ASB Bulletin*. In the event of a last-minute absence, notify Dr. Pezold at the above address or by phone, (318)342-1794, fax (318)342-1755 or email (bipezold@alpha.nlu.edu). **Information on the meeting and the sessions schedules will be available via the Internet (<http://www.nlu.edu/asb>).**

Please type or print carefully. Provide the phone/fax numbers and email address for the primary author only.

1.	Author(s):	
2.	Institution(s):	
3.	Phone: ()	Fax: ()
4.	E-mail:	
5.	Title (omit higher taxa--see No. 8 below):	

6. Check: ☐ Paper or ☐ Poster See notice on previous page. Further instructions will appear in the January *ASB Bulletin*.

7. PROJECTION EQUIPMENT: ☐ 35 mm slides, ☐ Overhead
 ☐ Other (specify): _____

TIME LIMIT for presentations and questions is 15 minutes. Plan on speaking for 10-12 minutes to leave time for questions.

8. **Recommended Section:** Check appropriate section(s) to which your paper/poster should be assigned. If you check more than one, rank sections as to your preference (with "1" being first preferred). Indicate **Higher Taxon** to help program committee in arranging papers (omit these from the title unless necessary). Paper sections will be established based on needs. Posters will be grouped by subject area.

☐ Animal ecology	☐ Cryptogamic botany	☐ Microbiology
☐ Animal physiology	☐ Cytology/Genetics	☐ Parasitology
☐ Aquatic/wetland ecology	☐ Developmental biology	☐ Plant ecology
☐ Cell/Molecular biology	☐ Evolution	☐ Plant physiology
	☐ Ichthyology/Herpetology	☐ Plant systematics
	☐ Invertebrate zoology	☐ Teaching biology
Other topic/higher taxon:		

9. **Abstract:** Since abstracts will be reproduced in the April *ASB Bulletin* by photo-offset, it is critical that abstracts be typed carefully in the box on the blue form, following the directions in detail. **Please use Roman, New Roman or Times Roman 12 point font. Do not use a dot matrix printer.** Additional copies of the form may be obtained from the Editor: Dr. J. K. Shull, email: shulljk@appstate.edu; phone: 704-262-2675; fax: 704-262-2127. **Please follow the directions on how to present your abstract, otherwise your abstract may not be included in the *ASB Bulletin*.**
10. **NOTE:** If you wish to be notified of the day and time of your presentation, please include a self-addressed, stamped post card with this Title Sheet. Indicate title, your name, and leave a blank for day and time. **The presentation schedule will also be available on the World-Wide Web at <http://www.nlu.edu/ASB>.**
11. **Awards:** If you intend to submit an abstract and manuscript, please select from the following categories (see this *ASB Bulletin* for instructions; some require a manuscript. All posters will automatically be considered for the Poster Award (\$200.)
- ☐ ASB Student Research Award (\$500) ☐ ASB Faculty Research Award (\$500)
- ☐ Odum Award (\$250) ☐ Aquatic Biology Student Award (\$100)
- ☐ NC Botanical Garden Award (\$100) ☐ SEASIH Ichthyology Award (\$100)
- ☐ SEASIH Herpetology Award (\$100)
12. Reprints of abstracts are not available. You may duplicate the printed abstracts from the *ASB Bulletin*.
13. **Important:** In case of error in your name or title when printed or questions about your presentation, please notify the Program Chair, Dr. Frank Pezold, as soon as possible – not the moderator of your paper session.

NOMINATION FOR ASB OFFICERS AND EXECUTIVE
COMMITTEE POSITIONS

DEADLINE: 1 NOVEMBER, 1997

To members of the Nominating Committee: I wish to suggest that you consider the following ASB member(s) in selecting nominees for officers and executive committee positions. (Please include the institutional address of each nominee.)

PRESIDENT-ELECT _____

VICE-PRESIDENT _____

EXECUTIVE COMMITTEE (two will be elected for three-year terms.)

MAIL To: Dr. Jim Ross, Cumberland College,
Williamsburg, KY 40769

NAME & ADDRESS OF NOMINATOR _____

**"TRAVEL" SUPPORT AWARDS FOR GRADUATE
STUDENT MEMBERS OF ASB**

DEADLINE: 2 FEBRUARY 1998

Limited funds are available to partially defray the expenses of graduate students attending the Annual Meeting. The awards are for lodging and meals only. Departments are urged to provide transportation for their graduate students. *Recipients must be members of ASB.* The guidelines for application are as follows:

- (a) *The recipient is a current member of ASB.*
- (b) The recipient must be presenting a paper or poster at the Annual Meeting and must include a copy of the abstract of the paper or poster to be presented.
- (c) The recipient must be currently enrolled as a graduate student in the department where he/she conducted this research.
- (d) Give a conservative, itemized estimate of meeting expenses including transportation. Student travel awards are granted on a competitive basis. Applicants must document expected expenses and list other sources of financial support for this meeting, including institutional aid, shared lodging and shared transportation.
- (e) In a paragraph, give a brief history of your education to date; indicate how many years you have been in graduate school and the expected date of completion of work for the degree, your major field of study and research, publications including those in press and in preparation, degree sought, name of major professor and any other pertinent details.
- (f) Give your source(s) of support while in graduate school; e.g. NSF, NIH, USDA, Teaching Asst., Research Asst., etc.
- (g) Include a letter of recommendation for an ASB support award from your faculty research advisor. This letter should comment on the work being presented and indicate the financial need of the student presenter. It should also indicate whether any departmental or other funding is available to the student.
- (h) Send application, with supporting letter, all in triplicate, to: Conley K. McMullen, Department of Biology and Chemistry, West Liberty State College, West Liberty, WV 26074, (304)336-8070.
- (i) Applicants will be notified of the decision of the Committee as soon as is practical. Recipients of the award will receive their checks at the meeting.

WHO IS YOUR FAVORITE TEACHER ?

Over the past decade, the ASB Meritorious Teaching Award has honored the following people: Elsie Quarterman, John M. Herr, Jr, J. Charles O'Kelley, James W. Hardin, Eloise B. Carter, T. Lawrence Mellichamp, J. Whitfield Gibbons, and Rebecca R. Sharitz. A complete list of all award winners since the awards inception in 1952 can be found in ASB Bulletin 44(1):2. In examining these lists, you should note two things. First, in the past decade the award has not been given on two occasions. We have many excellent teachers who are members of ASB. The reason the award was not given was either no one was nominated or insufficient nomination materials were submitted. Second, I would like you to examine the list to see if your favorite teacher is on that list. If not, wouldn't you like to see that teacher honored with the ASB Meritorious Teaching Award ? It's up to you. Teachers can't nominate themselves. If you have a favorite teacher you want to nominate, here is what you do. Talk with their students and colleagues, past and present. Have lots of them write letters supporting the nomination. Accumulate all these supporting letters and a current *curriculum vitae* of the nominee. Submit the materials, along with the Nominations Form to the Meritorious Teaching Award Committee and, hopefully, you can proudly watch your favorite teacher honored next year. Send the materials to: Dr. Ken MLeod, Chair of the ASB Meritorious Teaching Award Committee, Savannah River Ecology Laboratory, P. O. Drawer E, Aiken, SC 29802. If you have additional questions or need more information, call me at (803) 725-5309 or see the other article in this Bulletin describing the Meritorious Teaching Award. This year, let's make the committee work hard going through the supporting materials for a large number of nominees.

Thanks,

Ken M^eLeod, Chair,
Meritorious Teaching Committee

NOMINATION -- ASB MERITORIOUS TEACHING AWARD, 1998

 NAME:

 ADDRESS:

 TEACHING INTERESTS:

 NOMINATOR NAME/ADDRESS:

Supporting documentation:	letter of nomination	
(enclosed, in triplicate)	supporting letters	

<i>curriculum vitae</i>		additional information (list)	
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RESEARCH AWARDS

**ASB STUDENT RESEARCH AWARD (\$500) AND
ASB SENIOR RESEARCH AWARD (\$500)**

Given for an especially meritorious manuscript presented orally by the author(s) at the Annual Meeting. In order to qualify for presenting the paper, the author(s) must submit an abstract by the November deadline. Papers submitted for the competition must be received in triplicate and in their entirety by the January deadline and must be journal-ready manuscripts worthy of publication. The student award is given to the senior author if she/he is a graduate or undergraduate student at the time of presentation. Papers may be in press, but not published prior to the previous annual meeting.

Committee chairs:

Senior Dwayne A. Wise, Dept. of Biol. Sci., Mississippi State University, Mississippi State, MS 39762, (601)325-7579.

Student Jeri W. Higginbotham, Biology Department, Jacksonville State University, Jacksonville, AL 36265-9882, (205)782-5638.

EUGENE P. ODUM AWARD (\$250)

Given by the Southeastern Chapter of the Ecological Society of America, for the best ecological paper presented by a student. Undergraduate and graduate students are eligible and the student must be the sole or senior author. The paper must deal with a clearly ecological topic and should be presented in any of the following sessions: Aquatic Ecology, Plant Ecology, or Animal Ecology. One copy of the title and abstract should be sent to the Program Chair by November 15, and a second copy to Dr. John M. Aho, Department of Biology, Auburn University at Montgomery, Montgomery, AL 36117, (dartmoor@tango.aum.edu), phone(334)244-3787, FAX (334)244-3826.

ASB STUDENT RESEARCH AWARD IN AQUATIC BIOLOGY (\$100)

Sponsored by WILDCO, the purpose of the award is to encourage excellence in research in aquatic biology by undergraduate and graduate students. Students who are members of ASB and whose research is sponsored by a faculty member or biology professional who is also an ASB member are eligible. The paper must be based on research designed and completed by the student and the paper must be presented orally by the student as senior author in a regular paper session at the annual meeting. The manuscript must conform to the style and general content of peer-reviewed journals in the area of aquatic biology. It is intended that aquatic biology be broadly interpreted; for example, the research could involve an entomological project or an aquatic insect.

All students entering a paper to be considered for the award should send an abstract to the program chair by November 15, 1997 and a manuscript, in triplicate, to Dr. Jeri W. Higginbotham, Biology Department, Jacksonville State University, Jacksonville, AL 36265-9882, (205)782-5638. by January 15, 1998.

THE NORTH CAROLINA BOTANICAL GARDEN AWARD (\$100)

Given by NCBG (through the Southeastern Section of the Botanical Society of America and the Southern Appalachian Botanical Society.) This is awarded for a paper presented at the annual ASB meetings that best advances our understanding of the biology and conservation of the southeastern plants and thus contributes to the mission of the North Carolina Botanical Garden. Of special interest to the Garden are the rare plant species of the Southeast: why they are rare; how they interact with plants, animals, and their environment; and what can be done to ensure their survival. The paper may deal with a broad area including systematics, ecology and conservation. All individuals who are eligible to present at the ASB meetings are eligible for this award. They may be students, faculty or others. **Awards Committee Chair:** Dr. Peter White, Department of Biology, CB3280, University of North Carolina, Chapel Hill, NC 27599.

**SOUTHEASTERN DIVISION OF THE
AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS
OUTSTANDING STUDENT PAPER AWARDS
ICHTHYOLOGY PAPER (\$100); HERPETOLOGY PAPER (\$100)**

These awards are given for the outstanding papers in the disciplines of ichthyology and herpetology presented by student members of the Southeastern Division of the American Society of Ichthyologists and Herpetologists (SEASIH.) Both undergraduate and graduate students are eligible, provided they are sole or senior author and the paper clearly deals with a topic concerning ichthyology or herpetology. To be considered, submit title and abstract to the ASB Program Chair by 15 November, 1997. A second copy should be sent by the same date to the SEASIH President: Dr. Floyd Scott, Department of Biology, Austin Peay State University, Clarksville, TN 37044. Winners will be announced at the ASB banquet.

NOTE: A limited number of "travel" grants (\$50 each) are available to selected student members of SEASIH who will be presenting papers or posters in ichthyology or herpetology at the annual ASB meeting. Students seeking travel awards should provide a brief justification for their request by 1 February 1998 to Dr. Floyd Scott at the address above.

Institutions Hosting Annual Meetings of the Association of Southeastern Biologists

Agnes Scott College 1952	Univ. of Fla. 1948, 1963
Appalachian St. Univ. 1991	Univ. of Ga. 1937, 1938, 1957, 1968, 1987
Auburn Univ. 1941	Univ. of Ky. 1961
Duke Univ. 1939, 1956	Univ. of Miami 1942
Eastern Ky. Univ. 1982	Univ. of New Orleans 1976
Emory Univ. 1947, 1964	Univ. of No. Car. 1953
Fla. So. College 1970	Univ. of No. Car. at Charlotte 1989
Fla. St. Univ. 1958	Univ. of So. Ala. 1972
Furman Univ. 1997	Univ. of So. Car. 1946, 1967, 1986
Ga. So. Univ. 1974, 1996	Univ. of So. Fla. 1980
Louisiana St. Univ. 1954	U. of So. Miss. & Gulf Coast Res. Lab. 1988
Loyola Univ. 1960	Univ. of Southwest. La. 1983
Memphis St. Univ. 1969, 1984	Univ. of Tenn. 1949, 1959, 1981, 1995
Middle Tenn. St. Univ. 1985	U. of Tenn. at Chattanooga 1979, (2000)
No. Car. St. Univ. 1966, 1977	Univ. of Va. 1950, 1965
Old Dominion Univ. 1993	Vanderbilt Univ. 1940
The Citadel 1955	Va. Polytech. Inst. & St. Univ. 1975
Towson St. Univ. 1990	Wake Forest Univ. 1962
Univ. of Ala. 1951, 1978, 1992	Western Ky. Univ. 1973
Univ. of Central Fla. 1994	

REVIEWS

Maurice F. Mettee, Patrick E. O'Neil, and J. Malcolm Pierson. (Karl J. Scheidegger *illustrator*). 1996. **FISHES OF ALABAMA AND THE MOBILE BASIN**. Oxmoor House, Inc., Birmingham, AL, \$50.00 (hardcover). 820 p.

Ichthyologists have long-awaited a volume on Alabama fishes that would provide details of distribution, identification, and biology that were not included in the earlier *Freshwater Fishes of Alabama* by Smith-Vaniz (1968). Mettee *et al* synthesize a large body of knowledge in an informative format appealing to a diverse audience. The volume forms a bridge between the enormous and complex body of data gathered by fish biologists and the general public. The 1990s have witnessed a resurgence in state fish books, most of which include color photographs or illustrations. The authors have set a precedent in that tabulated material, distribution maps, fishes (except for three species), and 33 aquatic habitats are all shown in color. The book treats 296 species (one account includes two species in the *Gambusia* complex) in 29 families plus one hybrid (palmetto bass) in formal accounts and 326 species in 42 families plus the palmetto bass in a 12-page drainage table. The page size is 8.5 x 11 inches and binding is secure.

The goals established in the Preface are to enrich the understanding of anglers and general readers of Alabama's diverse fish fauna and its aquatic habitats and to provide ichthyologists and fisheries biologists "new species records, color maps relating species distributions to physiographic setting, and personal observations on species habitats and life histories." Ease of use is maximized by the convenient layout of the species accounts. Families are arranged in presumed phylogenetic order; within families, genera and species are arranged alphabetically. Each species account features a full-page color map of distribution within the Alabama/Mobile Basin and, on the facing page, are a color photograph (with three exceptions) and brief accounts of characteristics and adult size, distribution and status, and habitat and biology. All information is accessible to the reader without having to turn the pages or consult maps or plates elsewhere. This is the first regional volume available for the East Gulf Slope featuring color photographs of nearly all species, except for *Fishes of Tennessee* (Etnier and Starnes, 1993), which covers only a tiny portion of the upper Mobile Basin.

Introductory chapters provide descriptions of the natural setting of Alabama, fish anatomy (including how to make standardized measurements and counts), and fish distributions. Numerous color tables and figures are eye-catching and instructive; particularly useful are complex figures, such as the map of Alabama depicting 28 physiographic districts and five physiographic sections (p. 9). Descriptions of the natural setting of Alabama are concise and well written, providing the reader with the background to appreciate the diversity of aquatic habitats. Unfortunately, no descriptions of the natural setting of the Mobile Basin outside of Alabama are provided and maps in the species accounts delineate only physiographic sections and not smaller units. Because fish distributions often are related to smaller physiographic units than sections, as noted by the authors, the relationships of fish distributions to physiography outside of Alabama sometimes remain unclear.

The section on fish anatomy is intended to define and illustrate terms used in taxonomic keys. Although beneficial to nonprofessionals overall, several errors and omissions detract from its usefulness. Flounders are given as an example of fish "depressed from top to bottom" (p. 41) when they actually are flattened laterally (i.e., compressed). The positioning of figures depicting caudal fins and the text about them seems to confound caudal fin type (homocercal vs. heterocercal) with caudal fin shape. The illustrations on pp. 43-44 demonstrating how to make caudal peduncle scale counts and how to measure caudal peduncle length are inconsistent

with methods generally used by ichthyologists and elsewhere in the book (e.g., p. 323), possibly resulting in misidentifications.

The distributions and status of 326 species from 42 families are summarized by 16 watershed units in a 12-page color table. This table provides the only distributional and status information for 30 exotic, estuarine, primarily marine, or undescribed species not covered in species accounts. The status designations for some species that have been introduced widely are questionable, including listing *Morone saxatilis* as a "native marine species" for the Tennessee River drainage. There are occasional inconsistencies between the table and species accounts. *Lepomis auritus* is considered "introduced" in the species account for the Black Warrior and Choctawhatchee river systems and the Tennessee River drainage, but listed as "native" in the table.

Family accounts contain information on distribution, status, biology, and importance to humans, but comments on systematics are notably limited or, usually, lacking altogether. Keys for identification are accompanied by color photographs (keys to families) or numerous line drawings of excellent quality (keys to species). The color plate depicting 12 species of snubnose darters (p. 575) is well done and useful for comparative purposes, especially because several species were described recently and are not well known. Although we found the keys operational, several characters are of questionable utility. For example, pelvic fin-ray counts are used to distinguish *Moxostoma duquesnei* from *M. erythrum*, despite these counts being modally nine in both species in the Mobile Basin (Jenkins, 1970). Other characters (p. 444), such as "pores 4a and 4b of supraorbital sensory canal system" used in the *Fundulus* key are not defined or illustrated. In order to identify *Etheostoma whipplei* in the key to Percidae, one must choose "gill membranes broadly connected" (couplet 12, p. 570). All specimens of *E. whipplei* we examined from Alabama and elsewhere have separate gill membranes.

The spectacular distribution maps are unequalled in state fish books. These full-page dot maps are based on 9,244 collections from 3,716 localities in Alabama and the Mobile Basin and contain much original distributional information. The full page color layout allowed for collection sites to be plotted precisely and relationships of distribution to physiographic section to be visualized easily. One minor detraction is that the Piedmont and Blue Ridge are portrayed as a single physiographic section. This obscures the relationship of distribution to physiography for species such as *Etheostoma brevirostrum* and *E. scotti*, which are confined, respectively, to the Blue Ridge and Piedmont in the Etowah River system (Bauer et al., 1995). Small inset maps depicting United States distributions are less valuable because of inaccurate or imprecise plotting and inconsistencies. The ranges of the *Cycleptus elongatus*, *Fundulus bifax*, *Gambusia* complex, and *Esox niger*, are shown inaccurately. Inset maps for North American fishes that have been introduced widely sometimes show only the native range (*Pylodictis olivaris*), native and introduced range (*Oncorhynchus mykiss*), or native and part of the introduced range (*Salvelinus fontinalis*), but no label distinguishes which the map depicts. The few maps that purport to show only a certain part of the range are inaccurate. For example, the "native range" of *Micropterus dolomieu* is shown to include the Mobile Basin, where the species is considered (p. 551) to be introduced.

Nomenclature for common and scientific names generally follows Robins et al. (1991). Rationales for departures, though brief, usually are provided. The uses of *Lagochila* (vs. *Moxostoma*) for the harelip sucker and *Moxostoma* (vs. *Scartomyzon*) for the jumpocks are inconsistent with a recent catostomid phylogeny proposed by Smith (1992). A few inconsistencies in common names were also noted. *Lepomis miniatus*, the redspotted sunfish, is referred to as the "spotted sunfish" in the text of the species account. *Mugil curema* is referred to as either the "white mullet" (p. 742) or "silver mullet" (p. 38, 776).

Nearly all species accounts are accompanied by a photograph in life colors, few by a color photograph of a preserved specimen, and three (the extinct *Lagochila lacera* and *Fundulus albolineatus* and the extant, but rare, *Speoplatyrhinus poulsoni*) by a line drawing. Appreciation of the morphological diversity and beauty of Alabama's fishes is enhanced by these high quality photographs that, for sexually dimorphic species, feature a male at or near peak breeding condition. Thirty-three additional color photographs display the beauty and richness of Alabama and the Mobile Basin's aquatic habitats. Numerous photographs, however, including about 70% of the cyprinids, show a strong unnatural lavender hue in the fins that masks diagnostic pigmentation patterns and can hinder identifications.

While identification characteristics given in the species accounts supplement the keys and are useful, other characters critical for diagnosing species (e.g., meristic counts, pharyngeal tooth formulae) are missing from many descriptions. The authors' considerable fieldwork, yielded significant original information on distribution and biology. They have added new records for several species of limited occurrence in Alabama, spawning dates for *Carpiodes velifer* and *Cycleptus elongatus*, and observations of nest building by *Ichthyomyzon gagei*. Much of the original distributional and biological information was obtained from boat electrofishing, underscoring the value of this technique, particularly for collecting data on large, river-inhabiting species. Although systematic comments are included for few species, the reader is made aware of several unstudied or undescribed species needing more detailed analysis.

Following the species accounts is a 26-page appendix of species occurrence by Alabama counties. While this might be of some use to state resource managers, the space could have been used better covering topics of greater interest to a general audience. Worthwhile alternative topics might have included additional accounts of marine and estuarine species that sometimes occur in Alabama's freshwaters or descriptions of the physiography of the Mobile Basin outside of Alabama. The number of references (about 570) cited is considerably fewer than in comparable volumes (e.g., Jenkins and Burkhead, 1994), and only 87 are from the past ten years. To a large extent, this reflects the limited space allotted to details of systematics and biology in the species accounts.

Although technical accuracy is below the standard of contemporary state fish books (e.g., Etnier and Starnes, 1993; Jenkins and Burkhead, 1994), the value of original information provided is not diminished. The color range maps set a new standard for portraying dot-distributions of fishes. Stated goals of contributing original information on fish distribution and ecology, and relating distributions to physiography are met, although perhaps not outside of Alabama). We congratulate the authors for producing a state fish book unparalleled in its appeal to general readers and the publishers for offering it at a reasonable price. Having up-to-date distribution maps of Alabama fishes alone is worth the price and is a necessity for anyone seeking broad knowledge of the North American fish fauna. We highly recommend this book and already have used it on numerous occasions to check ranges of Alabama fishes or to verify identifications with the keys. Anglers, naturalists, fish biologists, and natural resources managers will want to add this reference to their libraries.

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Larson, R. 1996. Swamp Song. Univ. Florida press, Gainesville, FL. \$19.95. 200 p.

Florida is a state well endowed with water and wetlands. If one were to ask the average person to come up with a mental image of what would typify the state's landscape, chances are water would somehow be involved, be it a wave-washed beach or a dimly-lit swamp containing numerous cypress trees festooned with hanging growths of Spanish moss. Wetlands can be divided into two main categories, those that are open (marshes) and those that are forested (swamps). The author has chosen to focus on the latter in the present book. Most laymen think of swamps as "snake infested" noxious places, which should be avoided at all costs. The author has done an excellent job of conveying to the reader that these areas have their own beauty and fascination, and should be appreciated rather than abhorred by those who have never had the opportunity to see them closeup. The book (about 200 pages long) is well written and skillfully edited, and reads very easily, the result being that the reader is well along into the text before realizing it.

Since other swamps, which may contain many of the same species of plants and animals, occur along the coasts from the Carolinas to eastern Texas, information on Florida swamps is applicable to those areas as well. An in-depth discussion of the entire subject would obviously occupy many volumes, so the author has attempted to introduce his reader to the subject in a relative few pages. He has done an excellent job of selecting and summarizing the information at hand, and of providing the reader with the most important basic information. The chapters are well organized, and the convenient headings and subheadings allow the reader to refer easily back to a particular subject.

A short introduction, which provides some background information and history on Florida swamps, is followed by nine chapters, of which the first five serve as an introduction to the subject (what swamps are, how they were formed, means of exploration, what there is to see, where and when to see them), and the last four chapters review the flora and fauna contained therein. Chapters 1 and 2 provide the reader with information about the various kinds of swamps in the state (depression swamps, river swamps, strands, and hydric hammocks). Chapter 3 provides information as to how to find and explore them, including advice on dealing and hints on photography. Chapter 4 describes what can be seen in some of Florida's most ecologically significant swamps (Green Swamp, Fakahatchee Strand, Highlands Hammock.) The dramatic and colorful seasonal changes that occur are described in chapter 5. Aspects of

the natural history of the biota are presented in chapters 6 through 9: plants (chapter 6); invertebrates (chapter 7); fishes, amphibians, and reptiles (chapter 8); and birds and mammals (chapter 9). The book ends with a brief Epilogue, which discusses ways of protecting our swamps and asking what the future may bring.

Typographical errors seem to be nonexistent (at least I can't recall seeing any.) I have no reason to suspect factual errors, although the subject areas are so diverse that very few (and certainly not I) could claim to have a sufficiently broad level of expertise to make categorical statements regarding factual accuracy. One area in which I do have background knowledge, and would question the figure given in the book, pertains to sea level changes discussed on page 3, in relation to the origin and history of Okefenokee Swamp. It was indicated there that during the Pleistocene the Atlantic Ocean was as much as 150 feet higher than at present, this based primarily on information in a paper by Schlesinger (1978). More recent data suggest sea levels during the Pleistocene epoch were probably no more than about 90 feet above present mean sea level, as discussed in the text and illustrated on the graph of Tertiary sea-level changes in the paper by Vail and Hardenbol (1979). Were sea levels actually as high as claimed (150 feet), peninsular Florida would almost certainly have become completely separated from the mainland during the Pleistocene. In addition to recent geological evidence, there is biological evidence to suggest that peninsular Florida remained connected with mainland North America throughout this epoch, among the most compelling of which is the level of taxonomic differentiation of peninsular populations of fishes and other elements of the biota. It is now believed that the last complete separation of the peninsula was during the Pliocene (beginning about five million years ago), when sea levels were notably higher than today and which resulted in a long-term separation that is believed to have lasted about three million years (Vail and Hardenbol 1979).

In summary, this book has a great deal to recommend it. As a succinct and authoritative source of information covering the entire range of subjects relating to Florida swamps, the book is hard to beat, and the price is not sufficiently high as to be beyond the price range of most individuals.

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Beacham, W. (ed.) 1994. **The Official World wildlife Fund Guide to Endangered Species of North America**; 1995. **Beacham's International Threatened, Endangered, and Extinct Species CD-ROM**. Beacham Publ., Inc., Wash. Vol. 4. \$85.00 hardcover, 670 pp.; CD \$395.00.

Volume 4 is the most recent companion to the three volumes on Walter Beacham's summaries of the endangered species of North America that I reviewed previously in the ASB Bulletin (38:180-181, 1991; 40:151-152, 1993). Like the others before it, Volume 4 contains 1-3 pages of information on the description, habitat, current and historic range, behavior (for animals), status, and recovery plans for an additional 225 species listed under the U.S.

Endangered Species Act to July 1994. This brings the total number of species covered by this series to 897.

The majority of the species covered in this volume (94%) are plants. They are arranged by geographic location: continental U.S., California vernal pool habitats, central Florida, Puerto Rico, and Hawaii (by island). Except for the first grouping, the species accounts are preceded by an essay describing the habitats of and threats to the area. Animals covered in this volume are mammals (4), birds (5), reptiles (1), fish (12), mussels (14), snails (8), crustaceans (3), insects (6), and arachnids (1). Each species account has a black and white photograph, many of which are adequate to illustrate the general form of the species but are unlikely to aid in identification. This is especially true for the plants. There are 39 excellent color photos in an eight page signature. New features include a greatly expanded glossary of about 900 terms, a metric conversion table, and a cumulative index to all four volumes. The pagination starts where Volume 3 left off, with page 1649, and ends with 2319 total pages in this series. Bibliographic references and federal agency contact offices are included, as they were in the first volumes. I should note here that several of my students have discovered that some of the contact addresses and phone numbers in the earlier volumes are incorrect or are no longer functional.

The CD-ROM is not intended to be a companion to the four-volume series but a stand-alone reference with a variety of additional features. The information provided for each species mirrors that found in the published volumes but in addition there are color photos, vocalizations, and several pathways to obtain information on a specific species or those found in a specific state or region. All of the 897 species are included on the CD, as well as many species from around the world that have become extinct. I found this encyclopedic CD to be easy to use and very useful as a reference. It comes in DOS and Windows formats and can be obtained for IBM and Macintosh computers.

These two products are valuable additions to the reference literature on endangered and threatened species. The book, like the other volumes, is handsome, well bound, and easy to read. The CD provides another means of accessing the abundant information on these rare species and can be used by people of all ages. It would be an especially useful tool for middle and high school and college teachers.

Every library that has already purchased the first three volumes should add volume 4 on Beacham's series on endangered species to their shelves. The CD-ROM should be in every public, high school, and college library in the country. The book series and the CD would also be very useful to those who teach courses in conservation and endangered species biology.

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Gotelli, Nicholas J. and Gary R. Graves. 1996. Null Models in Ecology. Smiths. Inst. Press 368 pp. \$65 cloth, \$30 paperback.

This book presents the Tallahassee perspective on null models in ecology, specifically, randomization tests for patterns in community ecology. Chapters review previous work on diversity and abundance, size ratios and niches, co-occurrence, species area and biogeography, and food webs, and each chapter concludes with a paragraph of recommendations. The preface notes that one's opinion of this book may be determined by one's prejudices for or against this form of null models. As a proponent of informed use of randomization tests, I find this book

a good index to much of this literature, but inadequate as both a synthesis of lessons learned and as a guide to future applications of null models.

The traditional statistical concepts of null hypotheses are outside the aims of this book, yet it suffers from a lack of statistical theory at several levels. There are minor shortcomings: for example the introductory philosophical chapter claims that the failure to reject a null model is grounds for concluding that a mechanism is not operating; lack of statistical power is mentioned only as a property of flawed null models, not of inadequate sample sizes. More seriously, the theoretical concepts of sufficient and ancillary statistics and the conditionality of tests could provide a framework for assessing the validity of randomization tests.

Null models should include the effects of all factors except the factor of interest, for example differences in vagility and population density and habitat requirements and source populations but not competition. Unfortunately, randomization tests conditioned on the observed data are null models of sampling processes, not directly of ecological processes, and this book does not make the distinction clear. A null model of ecological processes A, B and C but not D usually does not directly map onto a sampling null model of constraints 1, 2 and 3 but not 4. My sense is that, for null models ranging from rarefaction curves to size ratios to coexistence, the connection between the null ecological factor model and the null sampling model determines the validity of any null model approach. It is difficult to specify correctly the appropriate randomization or bootstrap for complicated sampling problems; it is not always possible to tie a biological process to a sampling process.

Instead of such a conceptual framework, each chapter provides a collection of null models, specific criticisms of each and occasional rejoinders, and then rather facile prescriptions of specific techniques or approaches. For example, rarefaction curves and hypergeometric confidence intervals about them are presented as the be-all and end-all of diversity measures. This may be true enough for studies of vertebrates and vagile animals but is not true for vegetation, and both this distinction and the reason for the distinction are omitted. The "null model" of independent and equiprobable sampling of individuals is inappropriate for vegetation sampling (and questionable for the original Sanders benthic sampling) based on quadrats rather than individuals. This problem is addressed only obliquely in terms of randomness of the spatial distribution of individuals, and the recommendation is to treat the individuals as spatially random and thus independently sampled "unless a great deal of information is available on the spatial organization of the assemblage" (p. 28). Valid scale-dependent approaches to plant diversity exist, yet the reader is neither explicitly warned of the differences for plants versus animals nor pointed in the right direction. Similarly, for species co-occurrences, Jackson et al. (1992) is cited in another context, but its randomization procedures are ignored and a new procedure is recommended. The new procedure may or may not be better, more likely the differences between the two approaches make them more suitable to slightly different situations or questions, but the reader is afforded neither the tools nor the facts with which to judge.

More contentious applications such as species co-occurrence are covered in a rather incomplete manner. A reader should beware: such topics do not yet lend themselves to unbiased accounts, especially when presented anecdotally rather than in an analytical framework. The biases of Gotelli and Graves differ from mine.

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NEWS OF BIOLOGY IN THE SOUTHEAST

Jon R. Fortman-News Editor
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ABOUT PEOPLE AND PLACES

GEORGIA

The University of Georgia, Savannah River Ecology Laboratory. The Laboratory is now hosting students from the Ukraine and the Dominican Republic, as well as Ph.D. candidate *Jon Aars*, of the University of Oslo in Norway. Mr. Aars is a population ecologist working on studies of white-tailed deer and with some small rodents from Norway. He is working under the supervision of *Dr. Michael H. Smith*, laboratory director. More than \$19,000 of Georgia Lottery money will match the laboratory's U.S. Department of Energy funds to purchase a Geographic Positioning System. This state-of-the-art equipment processes radio signals in "real-time" and can fix a spot on the surface of the planet to within one foot. Another feature is a hand-held laser gun, which allows researchers to target distant objects and identify their positions. Its use is very helpful under tree canopies, because trees block the satellite signal. The hand-held laser pistol has a range of 40,000 feet. The new GPS equipment can help cleanup crews pinpoint contamination on the SRS, formerly a nuclear weapons materials production site; map every tree in a forest for use by future scientists, or map nesting sites for endangered animals. University of Georgia professor and Savannah River Ecology Laboratory senior ecologist *Dr. Rebecca Sharitz* has been awarded the Meritorious Teaching Award from ASB. The award, which includes a plaque and a \$1,000 prize donated by Carolina Biological Supply Co., recognizes one member a year "for meritorious teaching" and as "someone who has had a profound and positive influence on student." The annual award goes to a member of ASB who is active, or recently retired, who has taught biology in a southeastern institution for a least 10 years, and must not have administrative duties beyond the departmental level. Dr. Sharitz earned her Ph.D. in botany and ecology from the University of North Carolina at Chapel Hill.

MISSISSIPPI

Delta State University, Department of Biological Sciences. *Dr. Sherri L. DeFauw* joined the faculty in the Fall of 1996. She comes to DSU from McPherson College in Kansas. Her research interests include salamander systematics, herpetofaunal surveys and ecotoxicology. *Dr. William Hayes* and *Dr. Samuel Faulkner* attended NSF-funded biology workshops in Virginia and Oregon during the summers of 1996. *Mrs. Elizabeth*

Peeler retired in the spring of 1996. Liz and her husband, *Dr. Dudley Peeler* of the *University of Mississippi Medical Center*, plan to move to the Carolinas in the near future. *Dr. Grady W. Williams* was honored by the Mississippi State Legislature in March 1996 for his many contributions in biology and general education in Mississippi. *Dr. Malcolm K. McEwen* was invited in the summer of 1997 to conduct a microbiology workshop for teachers under the auspices of the American Society For Microbiology and the Waksman Foundation. *Dr. Samuel Faulkner* was promoted to Associate Professor of Biology in the Spring of 1997. He chaired the Division of Science Education's sessions at the spring meeting of the Mississippi Academy of Sciences in Biloxi. *Dr. William Hayes* was honored as the guest speaker at the annual Diggs Faculty Scholar Awards program at *Virginia Polytechnical University*, in April. He and his wife, *Dr. Carol Hayes*, represented DSU at the annual meeting of the Southern Regional Faculty and Instructional Development Consortium conference at *William and Mary*. DSU biology faculty have been active this past summer in teaching off-campus courses. *Dr. Sherri DeFauw* taught a field course in coastal ecology in Georgia. *Dr. Grady Williams* taught marine ecology at the *Gulf Coast Research Laboratory* in Ocean Springs, Mississippi. *Dr. William Hayes* taught stream ecology and animal behavior at *St. Louis University's Reis Biological Station* in the Missouri Ozarks, and *Dr. Samuel Faulkner* taught a course in field ecology.

The University of Mississippi, Department of Biology. *Dr. Drew Crain* (Ph.D. *University of Florida*) joined the department in Fall 1997. He is an ecophysiologicalist with research interests focused on the effects of environmental factors on endocrine function in non-mammalian vertebrates. Recent work has also explored the regulation of growth in sea turtles and alligators and the development of direct developing frogs. *Dr. Crain* will teach general physiology and graduate courses in his specialty.

NORTH CAROLINA

Appalachian State University, Department of Biology. *Dr. Bill Dobson* received a \$50,000 grant from the State of North Carolina for instructional technology enhancement to provide multimedia computer systems for use in the Biology Department classrooms. *Ms. Eileen Strahl* has received the Zigli graduate research award to fund her master's degree research. The award is given for the most outstanding graduate research project at the university.

East Carolina University, Department of Biology. *Dr. Susan J. McDaniel*, Associate Professor and Director of Undergraduate Studies, has retired after thirty years of service. *Dr. McDaniel's* teaching duties involved primarily Ornithology and Principles of Biology. Additional service to the University included eleven years as Associate Vice Chancellor for Academic Affairs and Director of Summer School. In May 1997, *Dr. McDaniel* was honored by a University-wide reception in her honor. *Dr. Richard Rheinhardt* has received a grant to study the ecology and needs of the feral horses on the Outer Banks of North Carolina. *Miss Samara Hamze*, a graduate student working with *Dr. Claudia Jolls*, received the 1997 Odum Award from the southeastern Chapter of the Ecological Society of America for excellence of her research and

presentation entitled: "The Distribution of Seedlings of the Great Lakes Endemic *Cirsium pitcheri*."

Meredith College, Department of Biology and Health Sciences. *Janice C. Swab* received the 1996-97 Pauline Davis Perry Excellence in Teaching Award which included a check for \$2,000. She and a colleague in the Department of Religion received a \$10,000 grant from the John Templeton Foundation to enhance the teaching of their course, "Issues in Science and Religion."

Wake Forest University, Department of Biology. Two additions to the Fall faculty are: *Dr. Miriam Ashley-Ross* (Ph.D. UC Irvine) is a vertebrate functional morphologist/bio-mechanist. She has been a Grass Fellow at the Marine Biological Laboratory, Woods Hole, MA. Her research interests include locomotion in sea horses and salamanders. *Dr. Clifford Zeyl* (Ph.D. McGill University) is a population geneticist. His research interests include the population genetics of yeast and the evolution of sex. He has been a postdoctoral fellow at Michigan State University since 1996. A major undergraduate program enhancement package will include the provision of an IBM Thinkpad laptop computer with the tuition for all incoming freshmen. Ph.D. student, *Brian Arbogast*, was one of only two winners of the 1997 Elizabeth Horner awards from the American Society of Mammalogists, and Ph.D. student *Derek Zeluier* received the Byrd-Dunn Award for the outstanding student paper at the annual meeting of the Southeastern Society of Parasitologists. *Gloria Muday* is one of the principal investigators in a NASA Specialized Center in Research and Training in Gravitational Biology. Dr. Muday, together with several collaborators at NC State University, is interested in understanding the role of calcium as a signaling molecule in plant gravity response. *Dr. David Anderson* recently received a 5-year NSF Career award, focusing on the behavioral ecology and evolution of reproductive biology in sea birds. A novel aspect of his current work is satellite tracking of movements at sea of the widely ranging albatrosses. Laysan and black-footed albatrosses in the vicinity of the Hawaiian Islands are being tracked by attached transmitters to test hypotheses linking the slow reproductive rates of these species to their foraging biology. The tracking data (X-Y coordinates varying in time) are distributed in near-real time to over 250,000 fifth and sixth grade students via e-mail and educational satellite networks so that these students can participate in the data analysis. Those students are from pre-selected school programs, but other schools that may wish to participate can contact Dr. Anderson's program at: <http://www.wfu.edu/albatross>.

TENNESSEE

The University of Tennessee Herbarium (*B. Eugene Wofford*, Director) has received a \$175,000 Collections Improvement grant from the National Science Foundation. *Massimo Pigliucci* and *Hilary Callahan* have received \$122,000, 2-year NSF grant for a project entitled "Response to light quality and photoperiod in *Arabidopsis*: plasticity and pleiotropy." The project is a direct development of Massimo's research on light reception mutants at Brown University and Hilary's first postdoc with Massimo. Pigliucci has been awarded the prestigious "Dobzhansky Prize" by the Society for the Study of Evolution. The prize is named after the evolutionary

geneticist Theodosious Dobzhansky. Massimo Pigliucci organized two symposia on phenotypic plasticity at meetings held in the summer of 1997 at Montreal and the Netherlands. He was also the speaker at the Third Cycle Studies at the University of Geneva (Switzerland). The proceedings will be published in book form by early 1998.

VIRGINIA

University of Richmond, Department of Biology. Over the past two years, the following new faculty have joined the department faculty: *Jeff Elhai* (Ph.D. State Univ. of New York at Stony Brook). Research: patterned differentiation of heterocysts in nitrogen-fixing cyanobacteria; *Krista Fischer-Stenger* (Ph.D. Medical College of Virginia/Virginia Commonwealth University). Research: immunosuppressive effects of drugs of abuse; *Paula B. Lessem* (Ph.D. Rutgers University). Director of Biology Laboratories. Responsibilities include preparation and instruction of laboratories in genetics and cell/molecular biology; *Penny S. Reynolds* (Ph.D. University of Wisconsin-Madison). Research: biophysical and physiological ecology; statistics, experimental design; *Peter D. Smallwood* (Ph.D. University of Arizona). Research: behavioral ecology, plant-animal interactions, foraging.

MUSEUMS AND BOTANICAL GARDENS

ALABAMA

Anniston Museum of Natural History. In June 1997, The Anniston Museum of Natural History presented "Herpfest V: A Celebration of Reptiles and Amphibians." Live snakes, turtles, lizards, and amphibians were on display; and hands-on activities taught visitors of all ages the importance of these creatures in the Earth's ecosystems. *Dr. George Cline* of *Jacksonville State University* and other speakers provided fascinating presentations on herpetology.

FLORIDA

Selby Gardens. *Dr. Meg Lowman*, Director of Research and Conservation and *Mr. Peter O'Reilly* from Queensland Australia, a visiting scientist at Selby, will represent the Gardens at the annual meeting of the Association for Tropical Biology in Costa Rica. Mr. O'Reilly pioneered the first canopy walkway in the world in 1981. This past July, Dr. Meg Lowman taught in a Rain Forest Educator's Workshop in Peru. she taught expedition participants about the biology and conservation of tropical forests. Selby Gardens received a \$32,527 grant from the Selby Foundation in support of its Environmental Education Program. Major funding from this grant will be used to transport school children to the Gardens for educational programs during the 1997-98 year.

MARYVILLE COLLEGE

TWO POSITIONS OPEN FOR BIOLOGISTS

Assistant Professor

Tenure-track position available late August, 1998 for broadly trained biologist with strong background in animal physiology to teach in a liberal arts tradition that emphasizes superior teaching. Ph.D. in animal physiology or closely related discipline required; teaching experience preferred. Primary teaching in animal physiology and vertebrate anatomy. Demonstrated ability with computer-based lab instruction desirable. Supervision of undergraduate research as well as teaching introductory courses for science majors and general education courses for nonscience majors expected. Maryville College is located within minutes of the major research facilities of Oak Ridge Associated Universities (MC holds associate membership), the University of Tennessee, and Oak Ridge National Laboratory. Applications received by December 15, 1997 are assured of full consideration. Send letter of application, curriculum vitae, undergraduate and graduate transcripts, and three original letters of reference (at least two of which fully address teaching experience and potential) to Dr. Robert Naylor, Chairman; Division of Natural Sciences; Maryville College; Maryville, TN 37804-5907.

Assistant Professor

Tenure-track position available late August, 1998 for broadly trained biologist with strong background in cellular/biochemical developmental biology to teach in a liberal arts tradition that emphasizes superior teaching. Ph.D. in developmental biology or closely related discipline required; teaching experience preferred. Primary teaching in developmental and cellular biology. Demonstrated ability with computer-based lab instruction desirable. Supervision of undergraduate research as well as teaching introductory courses for science majors and general education courses for nonscience majors expected. Maryville College is located within minutes of the major research facilities of Oak Ridge Associated Universities (MC holds associate membership), the University of Tennessee, and Oak Ridge National Laboratory. Applications received by December 15, 1997 are assured of full consideration. Send letter of application, curriculum vitae, undergraduate and graduate transcripts, and three original letters of reference (at least two of which fully address teaching experience and potential) to Dr. Robert Naylor, Chairman; Division of Natural Sciences; Maryville College; Maryville, TN 37804-5907.

ASB MEMBERSHIP DUES STRUCTURE

Please complete the information below, enclose check or money order payable to **Association of Southeastern Biologists**, and mail to Dr. Gerhard Kalmus, Department of Biology, East Carolina University, Greenville, NC 28785; (919)328-6306. bikalmus@ecuvn.cis.ecu.edu. The mailing label shows the year through which you are paid -- for example, if the date is 1996, you need to pay for 1997 and 1998. Please contact Gerhard Kalmus if there is an error; bikalmus@ecuvn.cis.ecu.edu. Thank you for your support.

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_____ Regular -- \$20; or Regular for 3 years -- \$50

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_____ Contributing -- \$50

_____ Sustaining -- \$100

_____ Patron -- \$500

_____ Library -- \$30; or Library for 3 years -- \$85

_____ Enrichment Fund Contribution (we have a \$2,000 challenge grant for the current year)

_____ Total Enclosed: Paid for 1997 ____; 1998 ____; 1997-98 ____



THE ASB BULLETIN
VOLUME 44, NUMBER 4, OCTOBER 1997

IN THIS ISSUE:

1997 MERITORIOUS TEACHING AWARD	187
ASSOCIATION AFFAIRS	189
CALL FOR PAPERS	189
1998 ASB MEETING	191
NOMINATION FORM FOR ASB OFFICERS AND	
EXECUTIVE COMMITTEE POSITIONS	193
SUPPORT AWARDS FOR GRADUATE	
STUDENT MEMBERS OF ASB	194
NOMINATION -- ASB MERITORIOUS TEACHING	
AWARD, 1998	195
RESEARCH AWARDS	196
REVIEWS	199
NEWS OF BIOLOGY IN THE SOUTHEAST	206

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Scanning electron micrograph of a termite. 55×

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PURPOSE

The purpose of this association shall be to promote the advancement of biology as a science by encouraging research the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. Members receive the *ASB Bulletin*.

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1998	April 15-18	Northeast Louisiana University, Monroe, LA
1999	April 14-17	University of North Carolina at Wilmington, Wilmington, NC
2000	April	University of Tennessee at Chattanooga, Chattanooga, TN

Development of free neuromasts in the dwarf seahorse *Hippocampus zosterae* (Syngnathidae): An SEM study

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Abstract

Embryos representing three different developmental stages of the dwarf seahorses *Hippocampus zosterae*, were collected from gravid males held in aquaria. The emergence and distribution of free neuromasts on the embryos were recorded using scanning electron microscopy, and compared with neuromasts on the adult. Free neuromasts first appeared in mid-term embryos, and persisted until late-term, at which time the total number of free neuromasts decreased. Throughout development seven visible neuromast lines were observed. The Supra-Temporal (ST) line appeared in early term embryos. Late term embryos possessed, in addition to the ST line, Supra-Orbital (SO) line, the Ventral- Mandibular (VM) line, the Infra-Orbital (IO) line, as well as some free neuromasts located near the future Post-Cephalic (PC) line. At full term, all lines were still visible. Two new lines, the Post-Temporal (PT) and the Post-Cephalic (PC) were added at full term. Most neuromast lines disappeared in adults. Total neuromast counts dropped about 50% from term embryos to adults. The Trunk Lateral line(T/L) became visible, along the midline of the body from the head to just above the beginning of the tail. Neuromasts along this line appeared to be grouped in twos and threes and were located between calcification spiracles. Development of canal neuromasts was not observed at any time in *H. zosterae*, thus raising some questions as to the relative importance and function of neuromasts in adult fish.

Introduction

Coombs *et al* (1988) described the lateral line in many fishes and amphibians. It is considered to be a component of the acoustico - lateralis system of vertebrates because it is related to those receptors located within the inner ear. Dijkgraaf (1962) indicated this system can be separated into two groups: the ordinary and ampullary. The former is made up of neuromasts, and the latter includes the ampullae of Lorenzini.

The lateral line is a series of mechanoreceptors responsible for detecting disturbances in the surrounding environment by locating prey both underwater (Alexander 1967) and at the water surface in such species as *Aplocheilichthys lineatus* (Schwartz 1965). Localization of a disturbance in the surrounding water can also be used to avoid predators and other obstacles (Dijkgraaf 1966; Hassan 1985; Fuiman and Magurran 1994). Some fishes with particularly sensitive lateral line organs can even detect motionless obstacles at short range. Likewise, the lateral line system allows some fishes to recognize sexual partners as during their sexual display many species show a phase in which partners mutually stimulate each other by creating small flows of water against their companions (Dijkgraaf 1966). Evidence supports the involvement of the lateral line system in coordination of swimming, maintenance of orientation, and schooling (Boord and Campbell 1977; Partridge and Pitcher 1980; Partridge 1981).

The mechanosensory lateral line consists of two components: free or superficial neuromasts distributed singly or in lines on the surface of the fish's body (Blaxter 1987; Webb 1989), and a canal system consisting of neuromasts enclosed in a series of pored canals on the head and trunk. The receptor organ of the lateral line system in fish and amphibians is the neuromast (Dijkgraaf 1962). Neuromasts are composed of receptor cells (hair cells) and supporting cells. From the top of each receptor cell protrudes a bundle of sensory hairs containing several kinocilia and hundreds of smaller, surrounding stereocilia. A gelatinous cupula, secreted by surrounding supporting cells (Hama 1965; Petraitis 1966), is attached to this bundle and extends outward 40 to 50 microns (Iwai 1967). Water movements cause a displacement of the cupula, causing the kinocilia to move against the stereocilia and thus resulting in a stimulus (Flock 1967).

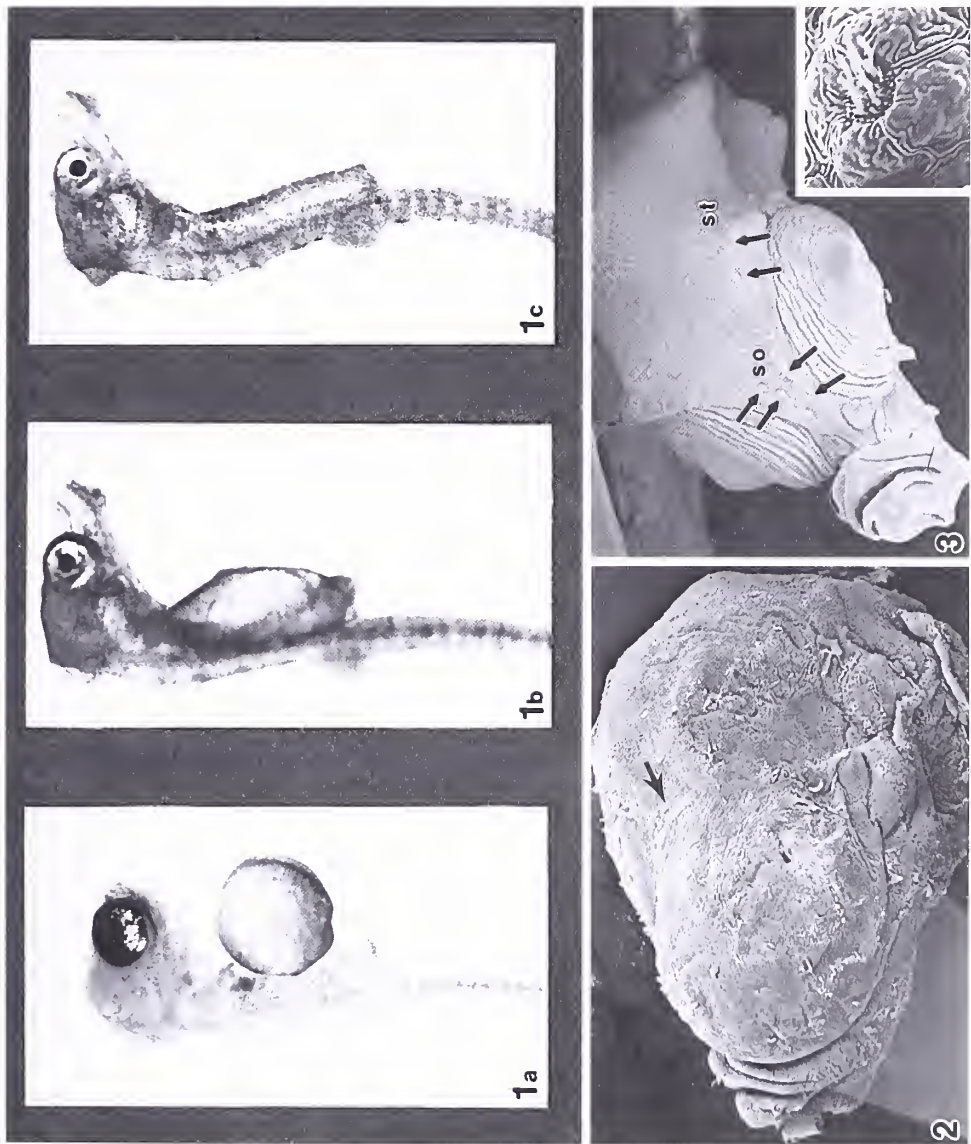
Neuromasts develop on the embryo starting from a lateral placode, an ectodermal thickening of the temporal region (Dijkgraaf 1962; Blaxter 1987; Coombs *et al* 1988; Metcalfe 1989; Jones and Janssen 1992). Collazo *et al* (1994) presented evidence of the dual embryonic origin of neuromasts with the contribution from neural crest cells. Ectodermal placodes become primary neuromasts and migrate to their final position prior to hatching. At hatching, the primary neuromasts have already erupted through the skin. Neuromasts in zebrafish larvae are mature and functional within five days after hatching (Metcalfe *et al* 1985). Thus, in the earliest stages of ontogeny, the lateral line system is present as superficial neuromasts. Secondary neuromasts can form by budding from the supporting cells of existing neuromasts or by arising from undifferentiated epidermal cells and neural crest cells (Lekander 1949; Blaxter 1987; Collazo *et al* 1994). As development continues, neuromasts are distributed along the head and the trunk of fish, either superficially on the skin, forming visible lines, or in grooves and canals (Coombs *et al.* 1988).

To date the lateral line of many species within such groups as cyclostomes (Yamada 1973), elasmobranchs (Roberts and Ryan 1971; Hama and Yamada 1977; Bleckmann *et al* 1989), and teleosts (Flock 1965; Hama 1965; Munz 1979; Best and Grey 1982; Blaxter *et al* 1983; Jorgensen 1985; Janssen *et al* 1987; Kawamura *et al* 1989; Harvey *et al* 1992) have been studied. The genus *Hippocampus* (seahorses) has received little or no attention with regard to its mechanosensory system. This study describes the development of the lateral line system, based on the developmental stages of *Hippocampus zosterae*.

Materials and Methods

Nineteen gravid male specimens of the dwarf seahorses, *H. zosterae* were maintained in aquaria, and the embryos were collected at three successive developmental stages: mid- term, late term, and full term (Fig. 1). Five adult specimens were used to compare fully formed neuromasts with the neuromasts emerging during the embryo developmental stages.

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- Fig. 1. Developmental stages of *H. zosterae*. a. mid term (14x); b. late term (10.5x); full term (10x).
- Fig. 2. Lateral view of cephalic region of mid term embryo showing neuromasts (arrow) in the Supra-Temporal (ST) region (72x).
- Fig. 3. Dorsal view of cephalic region of late term embryo showing the Supra-Orbital (SO) and the Supra-Temporal (ST) lines. Arrows point to neuromasts of both lines (50x). Insert: Free neuromast without cupula, sensory cilia visible (1350x).



Specimens were collected and fixed in 3% gluteraldehyde/0.1 M cacodylate buffer (pH 7.3) for up to 24 hours and then stored in 0.1 M cacodylate buffer under refrigeration until needed. Samples, in preparation for scanning electron microscopy, were post-fixed in a 1% osmium tetroxide solution for one hour and then rinsed twice in a 0.1 M cacodylate buffer solution for 0.25 hr. each. Specimens were then dehydrated in a graded series of ethyl alcohol solutions (50%, 60%, 70%, 80%, 90%, 95%) for 0.25 hr. in each concentration and then stored overnight in 100% ethyl alcohol. All fixed specimens were taken to the Electron Microscope Facility, Clemson University, and prepared for scanning electron microscopy work. After critical point drying using a CPD-100 model critical point dryer from Seevac, Inc., they were placed on aluminum stubs and sputter coated using a Hummer X sputter coater from Anatech Ltd. Observations were made using a Cambridge Stereoscan 90, JOEL JSM -IC 848, and a JOEL JSM -35CF. Photographs were taken using Polaroid type 55 film.

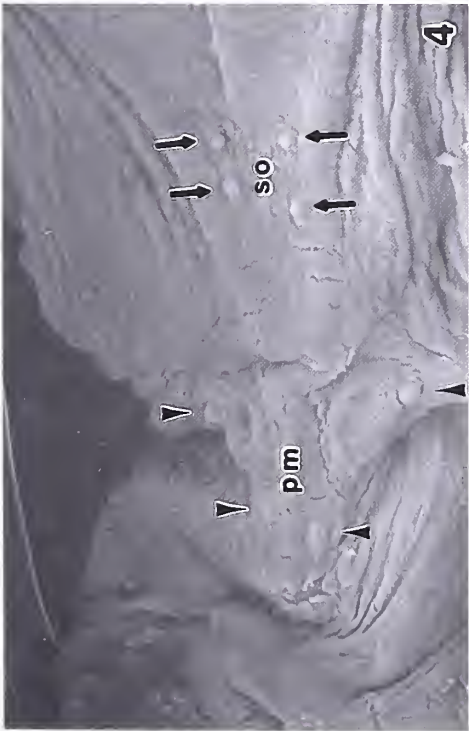
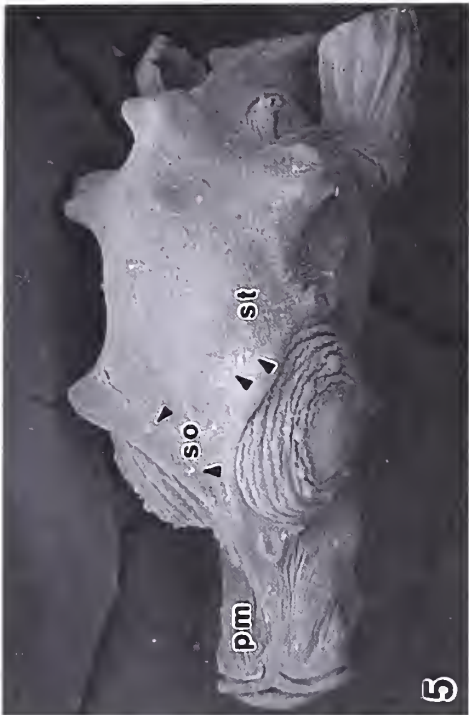
Results

Sixty five specimens were collected at intervals representing three different developmental stages (Wetzel and Wourms 1991) (Fig. 1). Superficial neuromasts were observed in *H. zosteræ* on mid-term, late-term, full-term embryos, and adults. Superficial neuromasts were grouped according to their positions on the head and trunk of the sample specimen. Eight superficial neuromast lines were observed during development: Supra-Orbital (SO), Supra-Temporal (ST), Infra-Orbital (IO), Posterior-Cephalic (PC), Pre-Maxillary (PM), Mandibular (M), Post-Temporal (PT) and the Trunk Lateral lines (T/L).

Neuromasts first appeared in the mid-term stage of development in the region of the ST line (Fig. 2). Neuromasts found on the ST axis ranged from four to five. No other lines were evident as the anterior portion of the SO axis could not be viewed as the snout had not elongated and separated from the main portion of the head. On late term embryos most neuromasts concentrated along the posterior portion of the SO and ST regions, ranging from three to six on the SO line and three to five on the ST line (Fig. 3). Neuromasts also defined the IO and M (VM - ventro mandibular) lines. One late-term embryo possessed six neuromasts located near the PC. Their presence at this stage was not consistent with other visible and distinct lines, such as the SO, IO, M (VM - ventro mandibular), and ST lines (Fig. 4) at this stage, hence we will not identify these neuromasts as the PC line.

Full term specimens showed extensive additions of superficial neuromasts to the IO, posterior SO, and especially the ST line region (Fig. 5). Neuromasts on the anterior portion of the SO axis were observed in a scattered arrangement. There were no canals present. The VM line region was noted to have eight neuromasts in only one specimen, fewer than in the previous developmental stage (Fig. 6). Along the dorsal side of the head of full term

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- Fig. 4. Dorsal view of anterior cephalic region of full term embryo showing the Supra- Orbital (SO) and the Pre-Maxillary (PM) lines. Arrows point to neuromasts of both lines (140x).
- Fig. 5. Dorsolateral view of the cephalic region of Full term embryo showing the Supra- Temporal (ST), Pre-Maxillary (PM) and Supra-Orbital (SO) lines. Arrows point to neuromasts of all lines (39x).
- Fig. 6. Ventral view of the snout of full term embryo showing the Ventral-Mandibular (VM) and Infra-Orbital (IO) lines (42.5x).
- Fig. 7. Posterior view of the cephalic region of full term embryo showing emergence (arrows) of the Posterior-Cephalic (PC) line and the Post-Temporal region (PT) (57.7x).



specimens, superficial neuromasts were noted forming a line for the first time along the PC region (Fig. 7). PC neuromasts were also more numerous than in previous stages and neuromasts appeared for the first time along the PT axis. Full term individuals showed an increase in superficial neuromast numbers in comparison with late and mid term samples.

Adult specimens showed an overall decrease in neuromasts and all previous neuromast lines disappeared with the exception of the posterior SO. In the anterior SO region, neuromasts were less concentrated. Ten neuromasts were noted, in one specimen, extending from the anterior SO region to the M region on one side of the snout. Most importantly, in the adult stage the first appearance of a discontinuous T/L line was noted (Fig. 8). Neuromasts appeared in clusters of twos and threes between calcification spiracles passing along the midline axis of the trunk (Fig. 9). Regardless, total neuromast counts decreased from the previous stage. After the visible neuromast lines disappeared in adult specimens, some neuromasts still were present but did not form a continuous neuromast line. Instead, they were singly and sometimes doubly interspersed throughout the cephalic region of *H. zosteræ* and appeared in a somewhat random arrangement. They were seen next to the olfactory organs where the previous anterior SO line appeared (Fig. 10), along the side of the anterior portion of the head (Fig. 11).

Discussion

Blaxter (1987) reviewed research on the lateral line system and was able to identify major trends. First, some free neuromasts, which may or may not be functional, are always present at hatching. This condition was observed on the midterm embryos of *H. zosteræ*, where neuromasts appeared in the ST region. Second, the number of free neuromasts increases with the growth of the larvae. This was also the case in *H. zosteræ* as increased numbers of neuromasts were seen in successive developmental stages. However, upon reaching maturity we noticed total neuromasts numbers decreasing. Third, canal formation is not seen upon hatching, but later in development. During development in *H. zosteræ*, no canals were formed. Many studies on both free and superficial neuromasts development as well as canal formation have been done. Herring (Blaxter *et al* 1983), sculpin (Jones and Janssen 1992), zebrafish (Metcalf *et al* 1985), all have superficial neuromasts at hatching, as does *H. zosteræ*.

The lateral line system of *H. zosteræ* followed a traditional and normal development. We were able to locate superficial neuromasts around the ST axis, on the dorsolateral portion of the embryos' head. These neuromasts were not randomly distributed, but resembled an early form of what was to become the ST line. Previous studies demonstrated the trend that as the

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- Fig. 8. Lateral view of the trunk of an adult specimen showing the discontinuous Trunk Lateral line in groups of two and three (arrows) along the midline axis of the body (51x).
- Fig. 9. Superficial neuromast (arrow) on an adult specimen located between two calcification spiracles (57x).
- Fig. 10. Two random superficial neuromasts on an adult specimen (arrow) located next to the olfactory epithelium of an adult (74x).
- Fig. 11. Random superficial neuromast on an adult specimen (arrow) located between two calcification spiracles (57x). (Blaxter 1987; Webb 1989). Observations of adult specimens did not reveal the presence of canal pores possibly indicating absence of canals.



fish grow, so do increased number of neuromasts develop into defined axis lines (Blaxter *et al zosteræ*. At each successive developmental stage, the neuromast lines became more evident through the additions of new neuromasts. This continued through the full term stage in which total neuromast counts peaked along every line with the exception of the M and posterior SO.

As development continues in most fishes, neuromasts are distributed across the head and trunk, forming visible lines and others are incorporated in grooves and canals (Coombs *et al* 1988). This suggests that trunk canals will form also in *H. zosteræ*. This however is not the case. Primary free neuromasts develop in the embryo from placodes and neural crest cells (Collazo *et al* 1994). Secondary free neuromasts may appear later by budding off from primary neuromasts or arising new. Most primary free neuromasts will move into canals, while secondary neuromasts remain on the body surface. No distinction was found in *H. zosteræ* between primary and secondary neuromasts and thus as development continues, the fate of primary neuromasts in relation to canals was questioned. No evidence of the presence of canal pores was found to support the possibility that canals were present or were forming.

This study elucidates the development of the lateral line in a novel species. Two characteristics observed are very interesting, namely the decrease in total neuromast number as development progresses, and the apparent lack of canal system along with the discontinuity of the superficial neuromasts of the trunk lateral line. Further studies are needed to substantiate possible relationship between these organizational patterns, the upright orientation and the distinctive swimming behavior of this species. Such studies can use other seahorse to verify the consistency of these observations and pipefishes which although very closely related to seahorses do not exhibit similar posture or swimming behavior.

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J. P. Shall, Dept. Biology, Appalachian State University, Boone, NC 28608

29. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities. If none, check box: ☒ None

30. Tax Status (For completion by nonprofit organizations authorized to mail at nonprofit rates):
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ASB Bulletin December 9, 1997

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Instructions to Publishers

- Complete and file a copy of this form with your postmaster on or before October 1, annually. Keep a copy of the completed form for your records.
 - Include in items 10 and 11, in cases where the stockholder or security holder is a trustee, the name of the person or corporation by whom the interest is being held. Also include the name and address of individuals who are stockholders who own or hold 1 percent or more of the total amount of bonds, mortgages, or other securities of the publishing corporation. In item 11, if none, check box. Use blank sheets if more space is required.
 - Be sure to furnish all information called for in item 15, regarding circulation. Free circulation must be shown in items 15d, e, and f.
 - If the publication had second-class authorization as a general or requester publication, this Statement of Ownership, Management, and Circulation must be published at least once in each issue of the publication in the first printed issue after October 1, if the publication is not published during October.
 - In item 16, indicate date of the issue in which this Statement of Ownership will be printed.
 - Item 17 must be signed.
- Failure to file or publish a statement of ownership may result in suspension of second-class authorization.

59TH ANNUAL MEETING IN MONROE, LOUISIANA

Northeast Louisiana State University and the Department of Biology welcome the Association of Southeastern Biologists to Monroe, Louisiana for the 59th annual meeting, April 15-18, 1998. Activities will be held on the NLU campus and at the Holiday Inn Holidome.

SOCIETIES MEETING WITH ASB IN MONROE

American Society of Ichthyologists and
Herpetologists, Southeastern Division (ASIH)
Beta Beta Beta (BBB)

Botanical Society of America, Southeastern Section (BSA)
Ecological Society of America, Southeastern Chapter (ESA)
Society of Wetland Scientists, South Atlantic Chapter (SWS)
Southeastern Fishes Council (SFC)
Southern Appalachian Botanical Society (SABS)

NORTHEAST LOUISIANA STATE UNIVERSITY AND MONROE, LA

Monroe, Louisiana is the urban center of northeast Louisiana. Approximately 140,000 people live in the Monroe/West Monroe metropolitan area. Monroe was founded as a predominantly French settlement in 1795. It was named Fort Miro for a Spanish governor of the territory. The city is located on the banks of the Ouachita River, chosen as one of the Ten Most Beautiful Rivers in America by National Geographic Magazine. Fort Miro was rechristened Monroe after the arrival of the first steamboat up the Ouachita, the James Monroe, in 1819. Monroe's major growth period in the 1800's was due to cotton production in the Mississippi Delta following the War Between the States (a.k.a. Civil War). Another major growth spurt occurred during the first two decades of the 20th century with the discovery of the largest natural gas field in the northern hemisphere just north of town. Monroe is the birthplace of Delta Air Lines and home to the first Coca-Cola bottling plant. More recently, major industry has settled here, including the State Farm Insurance Regional Office, General Motors Delphi Plant, headquarters of Century Enterprises and a regional office of the Chase-Manhattan Mortgage Company. Cultural history of the region far exceeds the establishment of the City of Monroe. About an hour east of town is Poverty Point State Commemorative Area and Watson Brake is an hour south. The latter, over 5,000 years old, is the oldest mound complex in the Western Hemisphere.

The weather in April should be mild, with highs in the middle to upper 70's and lows in the low to middle 50's. Rain gear may be necessary; Monroe averages eight rainy days in April. This would be an excellent time to visit a private garden, park or one of the many refuges in our area. Swamps, bottomland hardwood forests and pine-forested hills make up the natural countryside surrounding Monroe. There are five National Wildlife Refuges, 19 State Wildlife Management Areas and the Kisatchie National Forest within a one or two hour drive of Monroe. The Ouachita Mountains of Arkansas and the headwaters of the Ouachita River are a morning's drive away.

Northeast Louisiana University (NLU) is a state-assisted, multipurpose university located on a 238-acre campus on Bayou DeSiard in eastern Monroe. NLU is a young institution, established in 1931 as Ouachita Parish Junior College. In 1950 it became Northeast Louisiana State College. In 1970, it became Northeast Louisiana University and granted it's first doctoral

degrees. Most of NLU's 11,000 students are from the northeastern Louisiana parishes, but 42 states and 45 foreign countries are represented in the student body. Visit NLU at www.nlu.edu on the web.

The Department of Biology at Northeast Louisiana University offers undergraduate and graduate study that prepares students for careers or further education in one or more of the diverse areas of biology. The Department offers a Bachelor of Science degree and the Master of Science degree. There are 17 faculty members, more than 400 undergraduate majors and 30 graduate students. Facilities include a thermocycler, scanning electron microscope, greenhouses, research aviary, turtle research facility, herbarium and zoological museum. The fish collection of the Museum of Zoology is one of the largest in the world. More information is available on the department's home page at www.nlu.edu/biology/.

TRAVEL TO AND WITHIN MONROE

Automobile:

Monroe is located in northeast Louisiana on the edge of the Mississippi Delta. The city is easily accessed by I-20 from the west and east, and by Hwy. 165 from the north and south.

Air Travel:

The Monroe Regional Airport is located on the eastern edge of the city. Delta Airlines, which originated in Monroe in the 1930's, will be the Official Airline for the conference. Full size jet service is available with Delta. Four Seasons Travel Agency of Monroe (1-800-264-5777) can handle your airline reservations and ticketing at discounted prices. Ask for Frank Massony. Tell him that you will be attending the ASB meeting in April. Frank has arranged a 10% discount off the lowest published fare (if purchased at least 60 days in advance), 10% off the regular coach fare, or 5% off the lowest published fare purchased within 60 days of travel. He has also arranged special zone fare pricing for ASB participants with Delta. Other carriers serving Monroe are USAir, Northwest and Continental.

The Holiday Inn-Holidome will provide free shuttle service between the hotel and the Monroe Regional Airport for guests staying at the hotel. The La Quinta also provides this service, but the Stratford House Inn does not. Rental cars are available at the Monroe Regional Airport. Visitors staying at hotels without shuttle service are encouraged to make local travel arrangements with Four Seasons Travel Agency (1-800-264-5777) prior to departure.

ACCOMMODATIONS

Several official functions will be held at the Holiday Inn Holidome, 1051 US Hwy. 165 By-Pass. It will serve as the Primary Hotel for the conference. A block of rooms is available at a special rate of \$60.00 per room per night (four person maximum per room). Conference participants should make reservations directly with the Holiday Inn-Holidome prior to March 24, 1998 (800-465-4329; 318-387-5100). Be sure to mention the "ASB" when making your reservation. Another block of rooms is reserved for the conference at the La Quinta Motor Inn, 1035 US Hwy. 165 By-Pass. Rooms are \$55.10 per night (four person maximum). After March 24, reservations at both hotels will be taken on a space-available basis.

Other accommodations near campus include:

Budget Inn	318-322-8161	Travelodge Mid-City . .	318-325-5851
Motel Six	318-322-5430	Holiday Inn Atrium . . .	318-325-0641
Stratford House Inn . . .	318-388-8868	or	800-465-4329

Shuttle service will be available between NLU and the Holiday Inn-Holidome, La Quinta and Stratford House Inn (927 US Hwy. 165 By-Pass). The shuttle bus stop will be in the Holiday Inn-Holidome parking lot.

PRE-REGISTRATION AND REGISTRATION

A pre-registration form is provided with this copy of the *Bulletin*.
The **deadline** for receiving pre-registration materials is **March 19, 1998**.

Pre-registration is necessary to ensure the most effective planning for field trips, meals, and social events. Pre-registration packets will be available at the conference registration desk in the lobby of the Nursing Building on Wednesday, April 15, 1998 from noon-5:00 p.m. and Thursday, April 17, 1998 from 8:00a.m.-5:00p.m., and Friday from 8:00a.m. -12:p.m. Late registration will be held at the same times/location. Pre-registration fees are refundable, less an administrative fee, if cancellation notification is received by 5:00p.m., March 19, 1998 (contact Dr. Kim Marie Tolson: 318-342-1805; bitolson@alpha.nlu.edu). There will be a \$5.00 administrative fee for student cancellations and a \$10.00 administrative fee for non-student cancellations. *Fees are nonrefundable after March 19, 1998.*

PROGRAM INFORMATION

Please take your April 1998 *ASB Bulletin* containing the detailed program and abstracts to the meeting. Copies will be sold at the meeting registration desk for \$4.00. Detailed program information including the schedule of talks will also be available on the World Wide Web (www.nlu.edu/asb). Check the Web site frequently for the latest meeting updates.

Wednesday Evening ASB Social

A social with cash bar will be held in the Alumni Center from 7:30-10:00 p.m. Music will be provided by guitarist Marcus Chapman of the NLU Music Department. Shuttle service will be provided between NLU and the Holiday Inn Holidome. Hors d'oeuvres will be provided.

Thursday Evening Fais Do-Do

The Thursday evening gathering will be held from 6:30-10:30p.m. at NLU's Layton Farm Pavilion east of campus on US Hwy. 80. On the menu will be "all you can eat" boiled crawfish (*Procambarus clarki*), cochon de lait (*Sus scrofa*) stuffed with smoked sausage imported from Ville Platte, pasta salad (vegetarian), beer and other refreshments,

and live music provided by Steve Riley and the Mamou Playboys. Shuttle service will be provided from the Holiday Inn Holidome, the Holiday Inn Atrium, Budget Inn and Travelodge Mid-City. Guests of the Stratford House Inn and La Quinta are served by the Holidome shuttle. No private vehicles will be admitted to the event.

Friday Evening ASB Banquet

The ASB Banquet will be held from 6:30-8:30p.m. on the NLU campus. The entree will be a choice of chicken, beef or vegetarian lasagna.

Friday Evening Wind Down

Immediately following the banquet, 8:30-10:00, will be a final social gathering featuring the music of Amanda Dark and Enough Said. Amanda is the 1996 Grand Champion Louisiana State Fiddler and a student at NLU. She and her band will be playing classic and contemporary bluegrass to help us enjoy a final evening with our friends and colleagues. Free beer will be available to all banquet attendees if further relaxation is required!

TENTATIVE GENERAL SCHEDULE

Events will be split between the Holiday Inn Holidome and the NLU campus.

Wednesday, April 15

Copenhagen field trip departs from the parking lot of the Holiday Inn Holidome at 8:30a.m.

Copenhagen Paleontological Collecting field trip	8:30a.m.-1:00p.m.
Registration	noon-5:00p.m.
ASB Executive Committee Meeting	3:00-7:00p.m.
SFC Technical Advisory Committee Meeting	4:00-5:00p.m.
SABS Council Meeting	4:00-7:00p.m.
ASB Social Hour With Cash Bar	7:30-10:00p.m.
Continuation of ASB Executive Committee Meeting (if needed)	8:00-10:00p.m.

Thursday, April 16

Past Presidents' Breakfast	7:00-8:00a.m.
Poster Set-Up	7:00-8:30a.m.
Registration	8:00a.m.-5:00p.m.
General Plenary Session	8:30-10:00a.m.
Welcome by President Lawson Swearingen, Northeast Louisiana University	
Announcements by Local Committee	
Plenary Lecture, Dr. Leslie Real, Emory University	
Exhibits	9:30a.m.-5:00p.m.
Workshop Sponsored by ESA/SE Chapter and ASB Committee on Women, Minorities and the Disabled	10:00-11:00a.m.
Paper and Poster Sessions	10:00a.m.-5:30p.m.
SWS Luncheon Meeting	12:15-1:45p.m.

Herbarium Curators' Meeting	4:00-6:00p.m.
ASIH, SE Division Business Meeting	4:00-4:30p.m.
SFC Business Meeting	4:30-5:30p.m.
ASB Fais Do-Do and Crawfish/Cochon de Lait Fête	6:30-10:30p.m.

Friday, April 17

SABS and BSA, SE Section Breakfast and Business Meeting	7:00-8:30a.m.
Registration	8:00a.m.-noon
Exhibits	8:00a.m.-noon
Symposium: Bottomland Hardwood Restoration	8:00am-4:00pm
Paper and Poster Sessions	8:00a.m.-5:00p.m.
BBB Paper Sessions and Business Meeting	8:00a.m.-5:00p.m.
ASB Business Meeting and Election of Officers	11:30a.m.-12:30p.m.
BBB Luncheon	12:00-1:30p.m.
ESA, SE Chapter Luncheon and Business Meeting	12:30-2:00p.m.
Seminar: Biotechnology Education: Laboratory Applications	2:00-2:45p.m.
Dr. Brian Shmaefsky, Kingwood College Sponsored by the ASB Education Committee	
ASB Banquet and Awards	6:30-8:30p.m.
Social Wind Down	8:30-10:00p.m.

Saturday, April 18

Field trips depart from the parking lot of the Holiday Inn Holidome.	
ASB Executive Committee Meeting	8:00a.m.-10:00a.m.
Black Bayou Lake National Wildlife Refuge field trip (3 trips)	8:30a.m.-11:30a.m.
	11:a.m.-2:00p.m.
	1:30p.m.-4:30p.m.
Spring Birding field trip	7:00a.m.-till.
Middle Branch Bog & Longleaf Vista Trail field trip	7:30a.m.-5:00p.m.
Vicksburg National Military Park field trip	8:00a.m.-5:00p.m.

GUIDELINES FOR POSTER SESSIONS AND ASB POSTER AWARD (\$300)

Poster sessions have been incorporated as a regular means of scientific presentation at the annual ASB meetings. This type of presentation provides a more informal environment that encourages a direct interchange of ideas and discussion between presenter and audience. In order to stimulate greater use of posters as an effective means of presenting research results, ASB awards a \$300 cash prize to the best poster presentation. All posters will automatically be entered in a judging for the Poster Award.

Adherence to the following guidelines will help ensure the effectiveness of poster sessions.

- (a) Display should fit on a 4'h X 8'w board suitable for thumbtacks or pushpins.
- (b) Posters must be displayed from 10:00 a.m. Thursday through 5:00 p.m. Friday.
Authors will be required to be present at specified times during the annual meeting.
- (c) Posters should be carefully planned to maximize clarity and simplicity in conveying information.
- (d) Posters should have a heading including a title, author(s), and author(s) institution(s).
This heading should be placed at the top in letters **no less than three cm high**.
- (e) The body of the poster including text, figure legends and table captions, should be no smaller than **18 pt. (3-4 mm)** and *must* be legible from a distance of about one to two meters.
- (f) The body should be self-explanatory and should include figures, tables, graphs, maps or photographs displayed in a well organized and coherent sequence from top to bottom. Each illustration should include a caption. *Do not over crowd the display.*
- (g) A limited degree of text can be included, but care should be taken not to overwhelm the audience.
- (h) A large, abbreviated version of the abstract should be presented at the top of the poster but below the heading. A clear listing of specific conclusions should appear at the bottom or at the end of the presentation.
- (i) In addition to adherence to the above listed guidelines, poster presentations will also be judged using the following specific criteria:
 - (1) overall aesthetics and attractiveness of presentation.
 - (2) ease of reading from a distance (1-2 meters).
 - (3) clear and concise organization.
 - (4) clearly stated hypothesis.
 - (5) soundness of methods for testing hypothesis.
 - (6) how well conclusions are supported by results.

FIELD TRIPS

Transportation will be provided for all field trips. Box lunches will be provided for the Copenhagen, Middle Branch Bog, Vicksburg National Military Park field trips. No lunches are provided for the Black Bayou trips and the birding trip. Departures will be from the Holiday Inn Holidome. If you have questions about any of the trips, contact Kim Marie Tolson at NLU (bitolson@alpha.nlu.edu; 318-342-1805). Limits for trips may be raised if demand warrants.

1. *Copenhagen Upper Eocene Paleontological Site*

Wednesday, April 15, 8:30-1:00p.m.

The area around the small community of Copenhagen, Louisiana, is one of the most famous fossil sites in the state and has been known for its fossil vertebrates since the early 1800's. The fossiliferous exposures in the Copenhagen area of Caldwell Parish represent the most extensive and prolific marine sediments in the state and are approximately 38 million years old (Upper Eocene). Participants will be able to collect invertebrate and vertebrate fossils as well as bulk samples for processing. Handouts on the site as well as preliminary identifications of collected fossils will be provided. Travel time from Holidome: 60 min. Leader: Dr. Gary Stringer, Department of Geosciences, NLU. Limit: 25. Cost: \$15.00.

2. *Black Bayou Lake National Wildlife Refuge*

Saturday, April 18, 8:30a.m.-11:30a.m.; 11:00 a.m.-2:00p.m.; 1:30p.m.-4:30p.m.
(3 trips)

Black Bayou Lake is a new (1997) national wildlife refuge established in a unique partnership with the City of Monroe. This semi-urban refuge consists of 2,000 acres of high quality cypress-tupelo wetlands. Fauna includes those species characteristic of southern swamps: alligators, prothonotary warblers, anhingas, etc. Participants will view the area via boat. Additionally, the partnership approach to environmental education on this site will be reviewed. Travel time from Holidome: 15 min. Leader: Kelby Ouchley, U.S. Fish & Wildlife Service. Limit: 8 per trip. Cost: \$10.00.

3. *Spring Birding*

Saturday, April 18, 7:00a.m. till!

The Northeast Louisiana Bird Club invites ASB folks to participate in their weekly birding venture. The group will go to local hot spots for a morning of casual birding. Spring migration will be peaking! Leader: Dr. Jerry Liles, Northeast Louisiana Bird Club. Limit: 13. Cost:\$10.00

4. *Middle Branch Bog and Longleaf Vista Trail*

Saturday, April 18, 7:30a.m.-5:00p.m.

Middle Branch Bog is a large hillside bog in a longleaf pine woods. It should have a large display of pitcher plants, orchids, hatpins and associated plants. The Longleaf Vista Trail winds through a dry sandy upland complete with sandstone mesas and shrubs and herbs typical of longleaf pine forests. If time allows, a side trip will be made to nearby Kisatchie

Bayou to view trilliums and bay star vine. Travel time from Holidome: 2 hours. Leader: Dr. R. Dale Thomas, Biology Department, NLU. Limit: 13. Cost: \$18.00.

5. *Vicksburg National Military Park.*

Saturday, April 18, 8:00a.m.-5:00p.m.

Known as the "Gibraltar of the Confederacy," Vicksburg's fortifications on the river's eastern bluffs were a key to control of the lower Mississippi River. Vicksburg National Military Park was established in 1899 to commemorate one of the most decisive battles of the Civil War. Gen. Grant's Vicksburg Campaign included a 47 day siege of the town during which inhabitants fed on mules, rats and cats. The Fall of Vicksburg on July 4, 1863 was one of the turning points in the War, cutting a major Confederate supply route of troops, food, medicine and clothing. Included in the Park are the Vicksburg National Cemetery (established 1866), the restored Union gunboat Cairo and recovered trenches and earthworks, and more than 1300 monuments. You can also see part of the canal dug by Grant's troops on the Louisiana side in an attempt to divert the Mississippi River. A Park Ranger will guide the tour at the site. Travel time from the Holidome: 90 minutes. Leader: Dr. Scottie Legan, Department of History and Government, NLU. Limit: 12. Cost: \$20.00

6. *D'Arbonne National Wildlife Refuge:*

Saturday, April 18, 8:00 a.m.-4:00 p.m.

D'Arbonne NWR, located just north of West Monroe, consists of a deep overflow swamp and adjacent pine uplands with red-cockaded woodpecker colonies. Participants will visit an area of extensive willow oak dieoff (5,000 acres) and observe remedial techniques. The group will then travel to Morehouse Parish to view bottomland hardwood reforestation sites and an experimental native cane restoration plot. Travel time from the Holidome: 30 min. Leader: Kelby Ouchley, U.S. Fish and Wildlife Service. Limit: 25. Cost: \$15.00.

ON YOUR OWN: OTHER FIELD TRIP/TOURIST DESTINATIONS

1. *Tensas River National Wildlife Refuge:* One of the last haunts of the ivory-billed woodpeckers, this vast bottomland hardwood swamp is now renowned as a home of the threatened Louisiana Black Bear. Facilities include a visitor center with first class exhibits, nature trail, observation tower, etc. The refuge is located 12 miles southeast of Tallulah off I-20. Travel time from NLU: 90 min.
2. *Poverty Point State Commemorative Area:* This site features ancient Native American earthworks which date to 1200 B.C. A museum includes an audio-visual presentation and numerous artifacts found on the site. An archaeological laboratory, picnic areas, an observation tower and self-guided hiking trails complete the facility. The Area is northeast of Monroe near Epps. Travel time from NLU: 80 min.
3. *Elsong Garden and Conservatory:* The magnificent formal estate garden features thousands of flowering plants, seven water features and fine pieces of art selected from throughout the world. Soothing music, triggered by lasers, enhances the natural beauty of the gardens as you walk through its various settings. 2006 Riverside Drive, Monroe. 318-387-5281.

4. *Layton Castle*: Entered in the National Register of Historic Places under the name "Mulberry Grove," this 1814 raised cottage was encompassed with red bricks fired on the premises. This addition includes a massive tower, arcaded gallery, turret and porte cochere with its Romanesque columns. Group tours only. Admission fee. 1133 South Grand, Monroe. 318-322-4869.
5. *The Biedenharn Home and Emy-Lou Biedenharn Foundation Bible Museum*: Constructed in 1914 by Joseph Biedenharn, who was the first to bottle Coca-Cola in 1894, the house is filled with beautiful antique furnishings and a wonderful Fountain Gallery. 2006 Riverside Drive, Monroe. Free. 318-387-5281.
6. *Boscobel Cottage*: This plantation cottage (circa 1820) was furnished and restored in 1976. The lovely grounds include the state champion pecan tree. Privately owned and shown by appointment. Groups only, admission fee. Bed and Breakfast by reservation. 185 Cordell Lane, Monroe. 318-325-1550.
7. *Antique Alley*: Renovated 1880's downtown buildings catering to that hometown feeling. Featuring American and European furniture, glassware, jewelry, linens, baskets,, railroad items, quilts, Coca-Cola memorabilia, decoys, rugs, etc. Shops open 10-5 Tuesday-Saturday. 300 block of Trenton Street, West Monroe. 318-322-2691
8. *Kiroli Park and Gardens*: Features picnic facilities, tennis courts, playgrounds, nature trails for hiking, paved walkways for jogging or cycling, a fishing pond, and conservatory featuring waterfalls, banana trees and many other plants. Admission. 820 Kiroli Road, West Monroe. 318-396-4016.
9. *Louisiana Purchase Gardens and Zoo*: Landscaped gardens, winding paths and waterways form a picturesque setting for nearly 750 rare and exotic animals. The zoo offers boat and train rides and picnic areas. Open daily 10 a.m. Admission fee. Bernstein Drive, Monroe. 318-329-2400.
10. *Twin City Queen*: Docked at the Forsythe Boat Dock on the scenic Ouachita River, this paddlewheel vessel accommodates up to 240 passenger on her three decks. Call for public excursion information. Admission. 318-329-2225.

LOCAL ARRANGEMENTS COMMITTEE

Local Arrangements

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(318) 342-1805; bitolson@alpha.nlu.edu

Program

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and

Holiday Inn Holidome
1051 US Hwy 165 By-Pass
Monroe, La 71209
1-800-465-4329 or (318) 387-5100

**59th Annual Meeting Hosted by Northeast Louisiana State University
Monroe, Louisiana April 15-18, 1998**

PRE-REGISTRATION FORM

(Type or clearly print one form per registrant)

Name _____

☐ Faculty ☐ Graduate Student ☐ Undergraduate Student

Institution _____

Mailing Address _____

City _____ State _____ Zip _____

Office Phone ()

Email _____

Affiliation (check
where appropriate):

☐ ASB	☐ ASIH	☐ BBB	☐ BSA
☐ ESA	☐ SFC	☐ SABS	☐ SWS

Pre-Registration fee:

Regular: \$50.00 _____ \$ _____

Student: \$20.00 _____ \$ _____

Late registration: Regular \$65.00; Student \$25.00

Wednesday Evening ASB Social:

I plan to attend ☐

Thursday Evening BBQ Buffet:

Regular: \$25.00 x ____ tickets _____ \$ _____

Student: \$20.00 x ____ tickets _____ \$ _____

Friday Evening ASB Banquet:

Regular: \$25.00 x ____ tickets _____ \$ _____

Student: \$20.00 x ____ tickets _____ \$ _____

Entree preference: # fish ____ # poultry ____ # vegetarian ____

Breakfasts:

ASB Past Presidents \$7.00 x ____ tickets _____ \$ _____

SABS/BSA \$12.00 x ____ tickets _____ \$ _____

Luncheons:

Beta Beta Beta \$10.00 x ____ tickets _____ \$ _____

ESA/SE Chapter \$10.00 x ____ tickets _____ \$ _____

SWS \$10.00 x ____ tickets _____ \$ _____

Field Trips:

1. Copenhagen \$15.00 x ____ tickets _____ \$ _____

2. Black Bayou \$10.00 x ____ tickets _____ \$ _____

3. Spring Birding \$10.00 x ____ tickets _____ \$ _____

4. Middle Branch Bog \$18.00 x ____ tickets _____ \$ _____

5. Vicksburg \$20.00 x ____ tickets _____ \$ _____

Total Amount Enclosed _____ \$ _____**Museum and Herbarium Reservations:**

If you would like to have access to museum collections, please contact Dr. Neil Douglas at (318)-342-1799 or at "bidouglas@alpha.nlu.edu." Every attempt will be made to accommodate your needs, but scheduling may be "first come, first serve" for research space. Lab equipment beyond a microscope (forceps, etc.) cannot be furnished. If you wish to use herbarium collections, please contact Dr. R. Dale Thomas at (318) 342-1812.

Make checks payable to: ASB Local Committee**Pre-registration deadline March 19, 1998**

Mail pre-registration form and check to:

Dr. Kim Marie Tolson
Biology Department

**Northeast Louisiana State University
Monroe, LA 71209**

NOTE: To become a member of ASB, complete the application form in the back of this issue and send to Gerhard W. Kalmus, ASB Treasurer, with the appropriate dues.

ANNOUNCEMENTS

CORRECTION

**IMPORTANT NOTICE TO MEMBERS OF THE
SOUTHEASTERN DIVISION OF THE AMERICAN SOCIETY OF
ICHTHYOLOGISTS AND HERPETOLOGIST (SEASIH)**

The SEASIH student paper announcement printed in the October issue of the *ASB Bulletin* was in error. Please send applications for the best student paper awards and student travel grants to: Dr. Carol Johnston, Dept. of Fisheries and Allied Aquacultures, Auburn University, Auburn, AL 36849. Please share this with your students and associates who may have eligible students.

The announcement should have read:

**SOUTHEASTERN DIVISION, AMERICAN SOCIETY
OF ICHTHYOLOGISTS AND HERPETOLOGISTS
OUTSTANDING STUDENT PAPER AWARDS
ICHTHYOLOGY (\$100) HERPETOLOGY (\$100)**

Students who are sole or senior authors on papers and who are members of SEASIH may compete for this award in one of these two subject areas. To be considered, submit a copy of the abstract to the SEASIH president at the same time it is submitted to ASB.

Send applications for both awards to:

Dr. Carol Johnston,
Dept. of Fisheries and Allied Aquacultures
Auburn University
Auburn, AL 36849

**TRAVEL SUPPORT AWARDS FOR STUDENT MEMBERS OF THE
SOUTHEASTERN DIVISION, AMERICAN SOCIETY
OF ICHTHYOLOGISTS AND HERPETOLOGISTS**

Travel grants of \$50 each are available to a limited number of student members of SEASIH to attend the annual meeting. Applicants must be presenting a paper or poster at the meeting. Students seeking travel awards should provide a brief justification for their request and an abstract of their paper/poster by 1 February, 1998. Recipients must be present at the SEASIH business meeting to pick up their award.

MOUNTAIN LAKE BIOLOGICAL STATION SUMMER PROGRAM 1998

MLBS, located at an elevation of 4,000 feet in the mountains of southwestern Virginia, supports a summer community of diverse biologists.

COURSES may be taken for undergraduate or graduate credit. Students may pursue the master's degree in biology by summer study, a program that is particularly suitable for teachers in secondary education. Scholarships for tuition and service awards for room and board are available.

FIRST TERM

June 7 - July 11

Course Title	Instructor	Home Institution
BIOLOGY OF BIRDS	Daniel A. Cristol Assistant Prof. of Biology	College of William & Mary
FIELD BOTANY OF THE SOUTHERN APPALACHIANS	Charles Werth Assoc. Prof. of Biological Sci.	Texas Tech University
CONSERVATION BIOLOGY	Peter Kareiva Professor of Zoology & Michelle Marvier Research Associate	University of Washington University of Washington

SECOND TERM

July 12 - August 15

BIOLOGY OF FISHES	Mark Kopeny Assistant Prof. of Biology & Richard Raesly Associate Prof. of Biology	University of Virginia Frostburg State University
POPULATION ECOLOGY	Andrew Taylor Assistant Professor of Biology	University of Hawaii

RESEARCH Fellowships are available for post-doctoral and doctoral students. A ten-week program supports Research Experiences for Undergraduates in which students carry out independent projects in collaboration with research biologists from a variety of universities.

FURTHER INFORMATION:

Director, Mountain Lake Biological Station
Gilmer Hall, University of Virginia
Charlottesville, VA 22903-2477
www.virginia.edu/~mtlake
email: mtlake@virginia.edu

NORTH AMERICAN BENTHOLOGICAL SOCIETY
46th ANNUAL MEETING

The 45th Annual Meeting of the North American Benthological Society will be held on the campus of the University of Prince Edward Island, in the city of Charlottetown, PEI on June 2-5, 1998. The program features four days of invited and contributed presentations and workshops on the structure and function of benthic communities in aquatic ecosystems. The Plenary Session of the meeting will be: "Water Movements and Physical-Biological Coupling in Aquatic Ecosystems." Some special sessions include: "Tropical Streams", "Lotic-lentic Interactions", "Exotic Fish", and "Benthological Relevance of Hydraulics Across Different Scales." Both Teaching and Technical Workshops will be held during the meeting. Abstracts are due on January 4, 1998. Electronic submission of abstracts is encouraged, additional information can be obtained at the NABS Web-site (<http://www.benthos.org>) or by contacting the following:

Dr. Jill Lancaster, Programme Chair
Institute of Ecology & Resource Management
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SCOTLAND
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Dr. Donna Giberson
Local Arrangements Chair
Department of Biology
University of Prince Edward Island
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Charlottetown, PEI
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Tel: (902)566-0797
email: dgiberson@upepei.ca

REVIEWS

Helfman, G. S., B. B. Collette, and D. E. Facey . 1997. The Diversity of Fishes.
Blackwell Science, Malden, MA. \$69.96 (hard bound) 528 p.

Terrific, outstanding are just a few ways to describe, yet do not do justice to, the volume produced by Helfman, Collette, and Facey. Had we such a volume years ago it would have saved hours of effort plowing through myriads of volumes to find the many facts it contains. Our early problems stemmed from the fact that it has taken ichthyologists, and their subdisciplines, all these years to assess the information compiled and encompassed in *The Diversity of Fishes*.

Starting with the inside front covers, the phylogenetic relationships among living and selected extinct groups and the phylogenetic relationships among living teleosts are depicted; the back inside cover presents a geologic time scale depicting periods of occurrences and relative diversity of major fish taxa, based on the fossil record. One of the many strengths found in this volume is the suggested references, located at the end of each chapter. This saves time in locating important references treating material found in that chapter. Also important words or aspects are highlighted in the text or in boxes located within a chapter. The volume itself consists of six parts and 25 chapters. Helfman is responsible for Chapters 1, 8 through 15, and 17 through 25 while Collette handled Chapters 2 through 14, and 16; Facey wrote Chapters 5 through 7. Pages 471-507 contain 1688 references dating though 1996. A combined scientific and general index spans pages 509-528. Part I. Introduction, includes Chp. 1 The Science of Ichthyology; and Chp. 2 Systematic Procedures. Part II, Form, Function and Ontogeny, contains: Chp. 3, Skeleton, skin, and scales; Chp. 4 Soft anatomy; Chp. 5 Oxygen, metabolism, and energetics ; Chp. 6 Sensory systems; Chp. 7 Homeostasis; Chp. 8. Functional morphology

of locomotion and feeding; Chp. 9 Early life history, and Chp. 10 Juveniles, adults, age, and growth. Part III. Taxonomy, Phylogeny, and Evolution, treats: Chp. 11. A history of fishes; Chp. 12. Chondrichthyes; sharks, skates, rays, and chimeras; Chp. 13 Living representatives of primitive fishes; Chp. 14. Teleosts at last I: Bony tongues through angelfishes, and Chp. 5. Teleosts at last II: spiny-rayed fishes. Part IV. Zoogeography, Habits, and Adaptation contains: Chp. 16. Zoogeography, and Chp. 17. Special habitats and special adaptation. Part V. Behavior and ecology, contains: Chp. 18. Fishes as predators; Chp. 19 Fishes as prey; Chp. 20 Fishes as social animals: reproduction; Chp. 21 Fishes as social animals: aggregation, aggression, and cooperation; Chp. 22 Cycles of activity and behavior; Chp. 23. Individuals, populations, and assemblages; Chp. 24 Communities, ecosystems, and the functional role of fishes. Part VI. The Function of fishes, contains Chp. 25 Conservation.

Two major themes pervade this well-written and easy-to-read volume: ADAPTATION and DIVERSITY. The intended audience is senior undergraduate or graduate students taking an introductory course in ichthyology, although professionals will find many new facts within the volume that they can use in their courses or research. This book review would become too long if I pointed out the many interesting facts found in *The Diversity of Fishes*. Instead I will touch upon a few choice facts and then mention a few errors and disappointments.

Interesting facts are: coprophage fishes as fecal eaters (p. 440); pages 177 and 449 enlighten us as to how long it takes for a fish to evolve or become extinct (10 million years, p. 177). Many ways can be used to help resolve a fishes' relationship within a family or higher group (other than the classical way of morphology and morphometrics). leeches as a parasite host (p. 121), or blood hemoglobin data (Box 5.3, p. 60) can be used to show phylogenetic relationships. Fishes exist down to 8310 m (p. 296, but see below); eelskin wallets can be made from hagfish skins, not eels (Box 20. 1). etc.

Errors noted are: Figure 7.6 (p. 98) is upside down and the sexes are mislabeled; A and B are reversed in Fig. 29.6 (p. 438). Pike 1991 and Hoff and Castro 1991 (P. 193) are missing from the literature cited section. Aelepodiform, jellynose fishes (p. 237) are not in the index. Herdendorf and Berra (1995) are cited as published in *Copeia* when it should be *Transactions American Fisheries Society* 124(6):900-913. The food web depicted as fig. 248 (p. 442) is too small and blurry. Inquilinism or endoecism (P. 380) is not in the index. Sharks occur to 9938 m (Jensen and Schwartz, 1995) instead of 3690 (p. 191). No references are made to sturgeon caviar (p. 212) although it is noted for *Psephurus gladius* (Chinese paddlefish, p. 214). There is no mention of the growing importance of fishes via aquaculture as a means of replenishing a species' stock or what species are being used as a way to increase food production for human use. Box 9.1 (pp. 132, 133) contains information on how larval fishes reach shore but fails to mention the many other recent papers that point out how winds, currents, windows of opportunity, etc., guide larval fish into inlets, estuaries, and rivers for subsequent growth. Flounder eye movement is mentioned on pages 138-139 but no comment is made of the need for the frontal bone to be out of the way as the eye moves from one side to another; presence of the bone at the wrong time and in the wrong position causes ambicolorate and other odd colorations in adults (Powell and Schwartz, 1992). No mention is made that we now know some sharks have sex chromosomes (Maddock and Schwartz, 1996). One word, relatively, is overused; something is or isn't.

None of the above seriously detracts from the volume. The authors leave us with the observation (warning?): "All [conservation efforts] are doomed if human population growth and resource consumption cannot be checked." I fully concur and hope that the Doom and Gloom atmosphere that prevails today, regarding some fishes (sharks, salmon, haddock, billfishes, etc.), will be reversed by considering the many factors that influence or determine a fish's

presence or absence (i.e., currents, water temperatures, fisheries, seasons, habitat changes or destruction, species competition, El Niño, etc.). While we all want to live near water, let's not alter or hasten the world's waters that cover most areas of this planet. If we abuse this last frontier, we will continue to document how a species is affected or hastened into extinction as a result of our inconsiderate acts. Others, interested in fishes, should be able to be awed by fishes and their Adaptation and Diversity in the world they inhabit.

LITERATURE CITED

- Jensen, C. F., and F. J. Schwartz. 1995. Extreme habitat occurrences for two species of hammerhead sharks (family Sphyrnidae), in North Carolina and western Atlantic Ocean waters. *J. Elisha Mitchell Sci. Soc.* 110:436-68.
- Maddock, M. B., and F. J. Schwartz. 1996. Elasmobranchs cytogenetics : methods and sex chromosomes. *Bull. Mar. Sci.* 58(1):147-155.
- Powell, A. B., and F. J. Schwartz. 1972. Anomalies of the genus *Paralichthys* (Pisces: Bothidae), including an unusual double-tailed southern flounder, *Paralichthys lethostigma*. *J. Elisha Mitchell Sci. Soc.* 88(3):155-161.

FRANK J. SCHWARTZ, *Institute of Marine Sciences, University of North Carolina, Morehead City, NC 28557.*

Odum, Eugene P. A Bridge Between Science and Society. Sinauer Associates, Inc. Pub. Sunderland MA. \$24.95.

Introducing students to the multidisciplinary field of Ecology has always been a challenge, especially when those students are from many different backgrounds. This textbook slips so easily into technical terminology and the complexity of human interaction with the natural world that it is sure to be a well-used. While clearly designed as a multidisciplinary text oriented for non-majors' Ecology courses or Human Ecology courses, it contains virtually every term and concept embodied in any good "majors" course and could easily be used for such courses. Having just reviewed many books for a new Humans and Ecology course it is clear that Dr. Odum has avoided the tendency to add "fluff" at the expense of hard science terminology. He has managed this through introductory chapters that are loaded with examples and events that are known to most readers into which he injects ecological concepts. Later these concepts are developed more fully, but by that time such concepts seem obvious and will be easy to follow, even for the non-biologist.

Throughout most of the book there is the feeling that one is viewing each subject through the eyes of Dickens' three ghosts. Past problems and solutions seem crystal clear, present ecological problems are clouded by conflicting data and solutions, while the future is dark with both technical and political uncertainty. It is not always clear that this was the intention of the author, but the effect is exactly what students need. Chapters also include an irregular series of boxes each of which contain discrete snippets of information from Dr. Odum's own experience and interest. Each box deals with a subject appropriate to its place in the chapter but is self-contained enough to either be ignored or read without the text. The value of these to the reader will depend on interest and background.

There are suggested reading materials at the end of each chapter mingled with references. My preference would be to separate the two and lead the reader to each recommended title by categorizing them by topic, but this is a minor problem.

The only criticism of the text is the incorporation of chapters on the major ecosystems or biomes as they seem out of place in this book. While interesting, they disrupt the general flow of the book and seem rooted in classic ecology texts of a past era. They are not needed given the great integration in preceding chapters of examples from habitats in many different biomes. This space would have been better used for an expansion of the Epilogue which includes many of the cross-discipline concepts introduced in earlier chapters. Integration of economics and ecology, introduced in earlier chapters, but not well developed would be useful here. The lack of more integration of economics and ecology is the only omission from an otherwise very inclusive treatment of the subject that is easy to read and which will become a well-used introductory text.

COURTNEY T. HACKNEY, *Department of Biological Sciences, University of North Carolina at Wilmington, Wilmington, NC 28403*

Williamson, J.A., P. J. Fenner, J. W. Burnett, and J. Riflin (eds). 1996. **Venomous and poisonous marine animals: a medical and biological handbook**. Univ. So. Wales Press, Sydney. \$130. 504 p.

Not since Halstad's three volumes (or condensed versions) of Poisonous and venomous marine animals of the world, published in 1967, have we been treated to such a complete treatise of facts about venomous and poisonous animals. Seven sections containing 26 chapters written by 39 worldwide authors, and edited by four international experts in the field, enhance this book which is intended for medical, scientist, beach patrol, and the lay public. Eighty vivid color photos, between pages 208 and 209, depict the severity and effects of jellyfish nematocysts, echinoderm spines, platypus spines, or sea snake bites. An excellent glossary is found between pages 34-38, an up-to-date bibliography on pages 488-504, and even a key to categories of cnidaria and nematocysts between p. 170-173. The book pays tribute to W. McMaster, a life saver who treated many Australian sting victims for 58 years. While the volume is an outgrowth of the Australian marine Stinger books, it will be of use and interest to all for it treats many organisms that cause worldwide problems or harm via stinging, poisonings, etc. The majority of the volume treats the cnidaria (jellyfishes, sea anemones, corals; while coelenterates contain the coast jellies) which are, by far, abundant representatives in Australian and Asiatic waters. Hydrozoans, scyphozoans, cubozoans, and anthozoans are treated in detail: taxonomy, "anatomy", movement, nematocysts, feeding, how nematocysts are discharged (various theories-contraction, osmotic, tension, osmotic/tension), symptoms, and medical treatment.

Many interesting facts are found within the pages of this volume. For example, there are left and right handed *Physalia* and they sail 40° to the wind. Cold packs are the best treatment for *Physalia* stings. Most stings should not be treated with vinegar. Vinegar just increases the discharge of the nematocysts. Treat victims with embedded Echinoderm spines with hot water (p. 317) for best results. There is (p. 357) a treatment for fish ciguatera poisoning: 10-20% mannitol injected over 30 minutes to relieve severity and duration of the poison. If bitten by a sea snake use a compression/immobilization technique until, yes, sea snake anti-venom is given (p. 401). I'm sure the fisherman who was bitten during an otter trawl cruise I was on off Sri Lanka in 1966, would have given much to have such treatment then as he tried to escape the sea snakes pouring out of the bag of fishes caught.

Other documentation treats the increase in various stings and injuries since World War II. Perhaps, as developed by Australian lifeguards, our lifeguards and the general public should wear panty hose over their bodies when swimming, etc., to ward off jellyfishes, the technique

works. Likewise, while we use meat tenderizer to relieve jellyfish stings, we now learn that papain really only inhibits nematocyst discharge, rather than relieve the effects of the sting. Since there are as many as seven poisonous fish toxins, one should seek immediate medical treatment, for each has its own best treatment. Do not use vinegar, baking soda, rub with sand, crankcase oil or other substitutes to relieve the pains caused by venomous and poisonous marine animals!

FRANK J. SCHWARTZ, *Institute of Marine Sciences, University of North Carolina, Morehead City, NC 28557.*

NEWS OF BIOLOGY IN THE SOUTHEAST

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jfortman@sunmuw1.muw.edu

ABOUT PEOPLE AND PLACES

ALABAMA

Jacksonville State University. Drs. George Cline, Gary Durrant, Safaa Al-Hamdani, Frank Romano, and David Whetstone received a two extension of their NASA/EPSCoR grant. The project addresses changes in landcover types in the middle Coosa River drainage over a 15 year period, an analysis of forest types using satellite imagery, and an analysis of erosional soil loss off selected watersheds using satellite images. Dr. Tom Baucom, JSU Geography, also assists on the project.

FLORIDA

University of Florida, Department of Botany. New faculty are Dr. Kaoru Kitajima, Assistant Professor, from the University of Missouri, St. Louis. Dr. Kitajima specializes in Tropical Plant Ecology. Also, Dr. Stephen Mulkey, who comes from the Smithsonian Tropical Research Institute as an Associate Professor. His research is also in the area of Tropical Plant Ecology. The addition of these two faculty have helped greatly in recruiting graduate students in plant ecology. Richard Smith has retired from the department. A search is underway for a Plant Physiologist whose work will complement the research on (1) photosynthesis by George Bowes, (2) signal transduction by Alice Harmon, (3) functional ecology by Stephen Mulkey and

Kaoru Kitajima. Will McClatchey completed his Ph.D. in December 1996, and is now an Assistant Professor in Botany at the University of Hawaii. This is the second time a newly qualified Ph.D. from this department has gone to a faculty position without serving an apprenticeship as a Post Doc.

Florida Southern College, Department of Biology. Dr. Eric W. Kjellmark joined the faculty as Assistant Professor of biology in the fall of 1996. He came from the University of North Carolina where he had been working as a postdoctoral fellow. He received his Ph.D. in paleoecology from *Duke University*. His research interests are in the areas of paleoecology, fire ecology, plant community ecology, and effects of human disturbance.

GEORGIA

Savannah River Ecology Laboratory, The University of Georgia. Rebecca Yeomans, a University of Georgia Ph.D. candidate in ecology, has been awarded a \$6,000 grant to study "parental investment" in hatchling turtles. NSF funded only 30 proposals out of 130 submitted.

KENTUCKY

Morehead State University, Department of Biological and Environmental Sciences. Dr. David J. Eisenhour (Ph.D., *Southern Illinois University*) and Dr. David P. Smith (Ph.D., *University of North Texas*) are new members of the faculty for 1997-98. Dr. Eisenhour will teach Ichthyology and Vertebrate Zoology, and Dr. Smith will teach environmental science courses. Dr. Jerry F. Howell, Jr. retired from the University after 25 years of service. The department is now in renovated quarters: Lappin Hall, which includes a new greenhouse, growth chambers, and walk-in incubators, in addition to \$216,000 worth of new equipment.

Western Kentucky University, Department of Biology. Three new faculty have been added. They are: Dr. Albert Meier, Botany/Plant Ecology; Dr. Laura Rhoads, Animal Cell Biology, and Mr. Zhiyu Wang, Electron Microscope Facility Technician. Biology Professors Gary Dillard and Robert Hoyt have been designated Distinguished University Professors in recognition of long and meritorious service to the University.

LOUISIANA

Northeast Louisiana University, Department of Biology. Dr. Charles Edward DePoe died March 20, 1997 in Monroe, La. He was born September 18, 1927 in Southampton, New York. After serving in the United States Navy, he began his college career. He received an Associate of Applied Science degree in 1952 from New York University and Long Island Agricultural and Technical Institute. He earned a B.S. degree in both horticulture and zoology, a Master's degree in Horticulture and a Ph.D. in Botany from North Carolina State University. He began teaching at Northeast Louisiana University in the Fall of 1961. He was very active in numerous professional organizations including the ASB, and the Ecological Society of America. He served as President of the Louisiana Academy of Science. In 1966 he received the Annual Research Award from ASB, and in 1969 he was chosen as a Fellow in the American Association for the Advancement of Science. Dr. DePoe's efforts in the classroom were notable and on several

occasions he was chosen as a "Favorite Professor" by students in Alpha Lambda Delta. His colleagues chose him as the departmental nominee for an annual teaching award on four occasions. He was his college's nominee twice. He retired from active teaching in 1992, after 31 years at the University. He is survived by his wife of 44 years, Marie Jessie DePoe of Monroe.

MISSISSIPPI

Mississippi State University, Department of Biological Sciences. Dr. Lewis R. Brown was made a Fellow of the Society for Industrial Microbiology "in recognition of excellence in microbial research and on contributions made in administrative, academic, and governmental positions" at the annual meeting in Reno, NV, August 1997. He also was awarded a plaque "In Appreciation of His Vision, Leadership, and Dedication for the Establishment of the MSU Research Center at the Mississippi Test Facility 1969-1974" by the Science & Technology Research Center at the Stennis Space Flight Center on September 20, 1997. Dr. Jerome A. Jackson was elected President of the Inland Bird Banding Association and Vice President of the Association of Field Ornithologists for 1997-1998. Graduate Student, Keith Kimmerle, was elected Secretary of the Inland Bird Banding Association for 1997-98. Dr. Michael J. Sullivan was recently reappointed as Editor of the "Diatom Research" Journal.

Mississippi University for Women, Science & Math Division. Dr. Kajal B. Ghoshroy (Ph.D., University of New Hampshire) has joined the faculty as an Assistant Professor in Botany and Cell Biology. Dr. Kevin Kuehn (Ph.D., University of Alabama) is a Visiting Assistant Professor working with the General Biology course.

NORTH CAROLINA

East Carolina University, Department of Biology. Drs. Richard Rheinhardt and Mark Brinson received a supplemental public service award of \$11,952 from the Center for Transportation and the Environment for "Restoration Potential for small streams in the coastal Plains of North Carolina." Dr. Brinson was also recently honored by the ECU Board of Trustees for his exceptional research accomplishments and named a Distinguished Research Professor. He also received a Lifetime Achievement in Research Award. Brinson joined the Department of Biology in 1973. He has published 35 book chapters and articles and has administered 29 grants totaling more than \$1.3 million. His current research is focused on the effect of rising sea level on coastal marshes and the functioning of wetlands. In 1995 he received the National Wetlands Award for science research from the EPA and the Environmental Law Institute. Dr. Ariel Lugo, Director of the International Institute of Tropical Forestry (Puerto Rico) presented "Hot Issues in Tropical Forestry" at the distinguished Professorship Lecture honoring Dr. Brinson. Dr. Charles Bland, Biology Chair, accepted a new award, the Outstanding Unit Advising Award. Dr. Kyle Summers recently returned to campus from his research in Ecuador.

SOUTH CAROLINA

Converse College, Biology Department. Dr. Jerry H. Cromer has retired from the department after a career of twenty-nine years. The department has two new faculty members.

Dr. Edna Steele will be an Assistant Professor of Biology. Dr. Steele holds degrees from *Clemson University* and the University of the Philippines. *Dr. Isaure de Buron* will also be an Assistant Professor of Biology. Dr. de Buron holds degrees from *Universite Montpellier* and *Universite Rennes*.

VIRGINIA

Lynchburg College, Department of Biology. Dr. Gwynn W. Ramsey, Professor of Biology and curator of the Herbarium (LYN) for 32 years, retired in May, 1997, concluding a teaching and research career of 42 years. Dr. Ramsey is the author of the systematic treatment of *Cimicifuga* for the Flora of North America, volume III. He will continue to research the genus, publish on Virginia floristics, and curate LYN, which has 51,000 specimens. LYN is the fourth largest collection in Virginia and is especially rich with specimens from the central Blue Ridge and upper Piedmont of the state. LYN is the major repository for the Blue Ridge Parkway. for further information, contact Dr. Ramsey in the Department of Biology at 1501 Lakeside Dr., Lynchburg, VA 24501 or phone: 804-237-1768 or by e-mail, ramsey@hobbs1.lynchburg.edu, or gwr Ramsey@earthlink.net.

University of Richmond, Department of Biology. A new faculty member, *Dr. Peter Smallwood*, Assistant Professor of Biology will be teaching courses in organismal biology, behavior, and ecology. Dr. Smallwood received his Ph.D. in Ecology and Evolutionary Biology from the University of Arizona. His research interests encompass studies of the behavior of individual organisms as well as plant-animal interactions and their community-wide effects.

MUSEUMS AND GARDENS

ALABAMA

Anniston Museum of Natural History. The photographs of award-winning wildlife photographer *Thomas D. Mangelson* were on exhibit from August 16 through October 25, 1997. Entitled "Vital Signs: Images of Biodiversity," the exhibit focused on worldwide biodiversity and reveals the intricate webs connecting the wonders of our natural world. His stunning images are his message to humanity of the precious natural world we are in danger of losing; they capture life's vital signs of strength, fragility and incredible variety.

GEORGIA

The Columbus Museum. From Autumn 1997-1999, the Museum will present: "From Earth and Fire: American Art Pottery and Glass from the collection of the Chrysler Museum." A total of 59 works in ceramics, glass, and furniture.

ASB MEMBERSHIP DUES STRUCTURE

Please complete the information below, enclose check or money order payable to **Association of Southeastern Biologists**, and mail to Gerhard Kalmus, Department of Biology, East Carolina University, Monroe, NC 28785, (919)328-6306. The mailing label shows the year through which you are paid -- for example, if the date is 1997, you need to pay for 1998 and 1999. Please contact Gerhard Kalmus if there is an error. Thank you for your support.

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Address _____

City _____ State ____ Country _____

Zip Code _____ - _____ Telephone (____) _____

FAX (____) _____ EMAIL _____

_____ Regular -- \$20; or Regular for 3 years -- \$50

_____ Family -- \$25

_____ Student -- \$10

_____ Emeritus -- \$10

_____ Contributing -- \$50

_____ Sustaining -- \$100

_____ Patron -- \$500

_____ Library -- \$30; or Library for 3 years -- \$85

_____ Enrichment Fund Contribution (we have a \$2,000 challenge grant for the current year)

_____ Total Enclosed: Paid for 1998 ____; 1998 ____; 1998-98 ____



IN THIS ISSUE
THE ASB BULLETIN
Volume 45, Number 1, January 1998

DEVELOPMENT OF FREE NEUROMASTS IN THE DWARF SEAHORSE	
<i>Hippocampus zosterae</i> (SYNGNATHIDAE): AN SEM STUDY	1
59TH ANNUAL MEETING IN MONROE, LOUISIANA	11
ANNOUNCEMENTS	24
IMPORTANT NOTICE TO MEMBERS OF THE	
SEASIH	24
TRAVEL SUPPORT AWARDS FOR STUDENT	
MEMBERS OF THE SEASIH	24
MOUNTAIN LAKE BIOLOGICAL STATION	
SUMMER PROGRAM 1998	25
NORTH AMERICAN BENTHOLOGICAL SOCIETY	
46TH ANNUAL MEETING	26
REVIEWS	26
NEWS OF BIOLOGY IN THE SOUTHEAST	30

Cover photo by Dr. Deborah Waller, Old Dominion University, Norfolk, VA

PATRON MEMBERS

Associated Microscopes, Inc. Burlington, NC
 Breedlove, Dennis and Associates, Inc. Orlando, FL
 W. C. Brown Publ. Co., Dubuque, IA
 Carolina Biological Supply Co., Burlington, NC
 Lockheed Martin Energy Research Corporation, Oak Ridge, TN
 Martin Microscope Co., Easley, SC
 Saunders College Publishing Co., Philadelphia, PA

The ASB BULLETIN

Volume 45, Number 2

April 1998

SEE REVISED REGISTRATION FORM PAGE 72

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Northeast Louisiana University, Monroe, LA, Host of the 59th Annual Meeting

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PURPOSE

The purpose of this association shall be to promote the advancement of biology as a science by encouraging research, the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. Members receive the *ASB Bulletin*.

TIME AND PLACE OF FUTURE MEETINGS

1998	April 15-18	Northeast Louisiana University, Monroe, LA
1999	April	University of North Carolina at Wilmington, Wilmington, NC
2000	April	University of Tennessee at Chattanooga, Chattanooga, TN

PRESIDENT'S CORNER

A VIEW FROM HERE

As we approach the 59th Annual Meeting of the Association of Southeastern Biologists, I would like to invite all members to attend, with a special encouragement to urge your students to accompany you. The meeting at Northeast Louisiana University (NLU) in Monroe, where Delta airlines originated in the 1930s, promises to be an outstanding one. We are all indebted to Kim Marie Tolson and Frank Pezold of NLU for their diligence and careful planning to make the meeting a success.

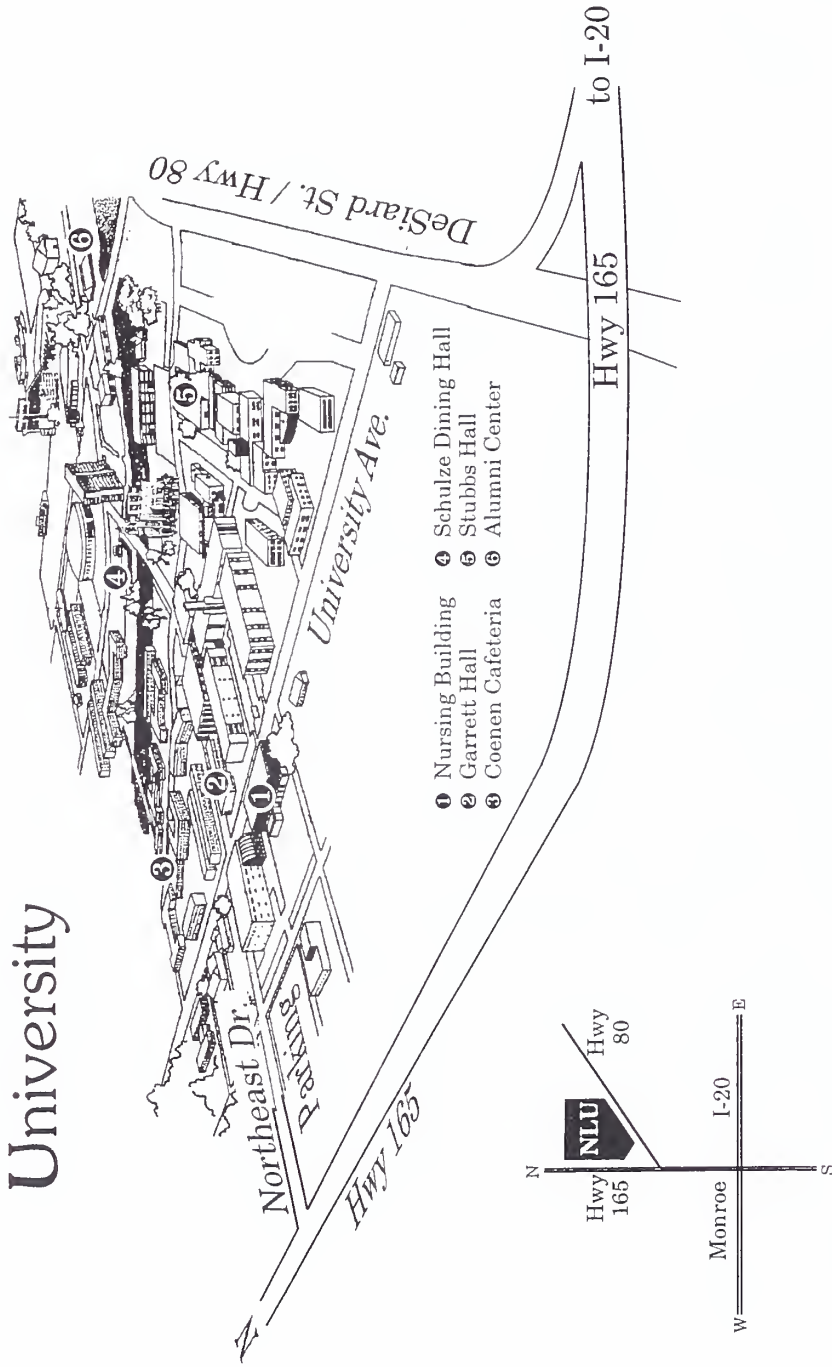
Among recent developments in ASB has been the building of our website by Vice President Howie Neufeld and his associates at Appalachian State University. The site can be accessed at <http://www.asb.appstate.edu/index.htm>. Current announcements and membership applications as well as information on travel support and awards are all available through this service. I particularly call your attention to the Patrons category, which will feature links to organizations that have provided and continue to provide a valuable service to our organization. The ASB patrons have served an extremely important service over the years in providing awards for the meetings or simply making donations to be used in a discretionary manner by ASB. I would like to take this opportunity to assure all of our patrons that the officers and members of ASB are appreciative of their support.

An additional website to check prior to the upcoming meeting is one provided by NLU, called ASB on the Bayou! at <http://www.nlu.edu/asb>. The website offers information on travel arrangements and accommodations, maps of the NLU campus and the city of Monroe, as well as details about the meeting, field trips, and registration. Again, I thank Kim Tolson and Frank Pezold for their organizational skills that will assure that the 59th meeting will be one of our best.

So, when you are at the meetings, take a moment to thank our hosts for their efforts and our patrons for theirs. The dedication of such individuals and organizations is what makes ASB continue as a dynamic organization serving biologists of the southeastern region.

Whit Gibbons, President
Association of Southeastern Biologists

Northeast Louisiana University



PROGRAM of the
59th ANNUAL MEETING of the
ASSOCIATION OF SOUTHEASTERN BIOLOGISTS

April 15-18, 1998

Hosted by:

NORTHEAST LOUISIANA UNIVERSITY
DEPARTMENT OF BIOLOGY

at the

Northeast Louisiana University Campus

and the

Holiday Inn Holidome
1051 US Hwy 165 By-Pass
Monroe, Louisiana

Societies Meeting With ASB in Monroe:

American Society of Ichthyologists and Herpetologists,
Southeastern Division (ASIH)

Beta Beta Beta (BBB)

Botanical Society of America, Southeastern Section (BSA)

Ecological Society of America, Southeastern Chapter (ESA)

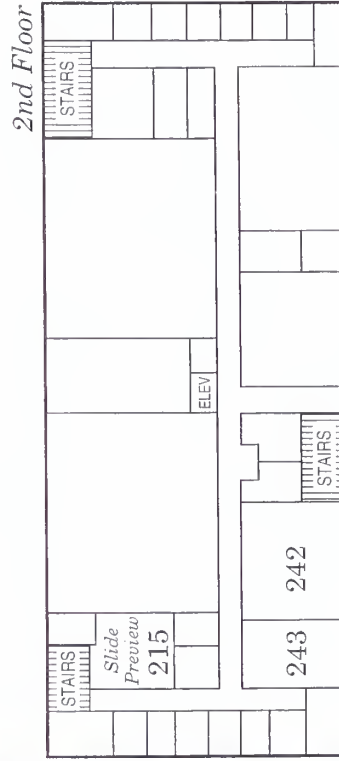
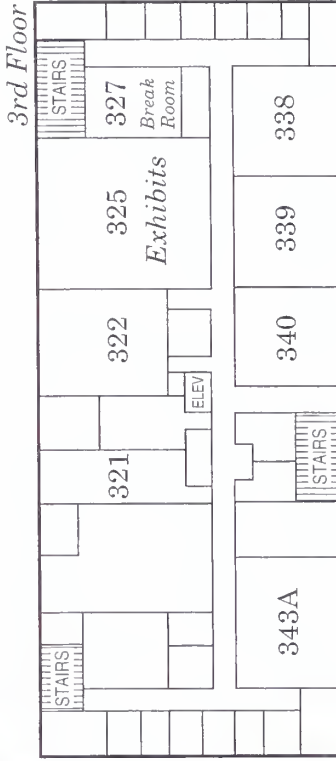
Society of Wetland Scientists, South Atlantic Chapter (SWS)

Southeastern Fishes Council (SFC)

Southern Appalachian Botanical Society (SABS)

Meeting Rooms

Nursing Building



University Avenue



Beautiful Bayou DeSiard winds through the 228 acre NLU campus. The bayou is a focus for student recreation and provides an urban sanctuary for alligator snapping turtles, shore birds and an occasional alligator.

GENERAL INFORMATION

Registration - Registration information and the pre-registration form were published in the January 1998 issue of the *ASB Bulletin* and are also available at the web address - www.nlu.edu/asb. Pre-registrants may pick up their registration packet at the ASB registration desk. The registration desk will be located at the Holiday Inn Holidome Wednesday, April 15, noon to 5:00p.m., The desk will be in the foyer of the Nursing Building at NLU Thursday, April 16, from 8:00a.m. to 5:00p.m., and Friday, April 17, from 8:00a.m. to noon. Please bring your April issue of the *ASB Bulletin* to the conference. Additional copies will be for sale at the ASB registration desk at a cost of \$4.00. The program (without abstracts) is also available at the web address given above. For further information contact Dr. Kim Tolson, Department of Biology, Northeast Louisiana University, Monroe, La 71209 (318-342-1805; bitolson@alpha.nlu.edu).

Ground Travel - If you are traveling from Memphis take Hwy 61 to Leland, MS. Take Hwy 82 to Montrose, AR. At Montrose, take Hwy 165 south to Monroe. To get to campus, take a left at Northeast Drive (second stoplight south of Bayou DeSiard). To get to the Holiday Inn Holidome continue south on Hwy 165. Turn right onto the service road just before the interchange for I-20. Continue south on the service road and cross under the overpass to the opposite side of Hwy 165.

From north Texas and Shreveport take I-20 east to Monroe. Get off at the Hwy 165 exit headed north for the Holiday Inn Holidome and the NLU campus. The Holidome is at the interchange. To get to campus, continue north on Hwy 165 to Northeast Drive (fourth stoplight). Take a right on Northeast Drive.

From Jackson, MS, take I-20 west to the north Hwy 165 exit at Monroe. To get to campus or the Holidome, proceed as directed above (as from Shreveport).

From New Orleans, take I-10 west to I-55. Take I-55 north to Crystal Springs, MS. Get off at the Hwy 27 exit and head west on Hwy 27 to Vicksburg. Take I-20 west to the Hwy 165 exit in Monroe. Proceed as directed above (as from Shreveport) to reach campus or the Holidome.

From south-central and southwest Louisiana, head to Alexandria and take Hwy 165 north to Monroe. Proceed as directed above (Shreveport) to get to the campus or the Holidome.

If you need additional directions, please contact Dr. Frank Pezold, Biology Department, Northeast Louisiana University, Monroe, La 71209 (bipezold@alpha.nlu.edu; 318-342-1794).

Air Travel - The Monroe Regional Airport is located on the eastern edge of the city. The Holiday Inn-Holidome will provide free shuttle service between the hotel and the Monroe Regional Airport for guests staying at the hotel. The La Quinta also provides this service, but the Stratford House Inn does not. Rental cars are available at the Monroe Regional Airport. Visitors staying at hotels without shuttle service are encouraged to make local travel arrangements with Four Seasons Travel Agency (1-800-264-5777) prior to departure. To get to campus from the airport, take Central Ave. to Kansas Lane. Turn right on Kansas. When the road ends at DeSiard, turn left. Follow DeSiard to NLU. Turn right on University Drive.

Parking - Parking will be available on campus. Follow signs from the Northeast Drive and University Drive entrances. Parking passes will be available for registrants at the registration desk in the Nursing Building.

Job Placement and Message Boards - Position notices and messages will be displayed near the ASB registration desk in the Nursing Building.

Local Dining and Entertainment - A list of area restaurants with sample menus and local night clubs, etc. will be posted near the registration desk. Some information will also be provided in the registration packet.

Social Activities and Events - Tickets for social events will be included in the registration packets for those who have pre-registered for the events. Times and places for activities and meals are given in the program schedule in this bulletin and on the web site (www.nlu.edu/asb). A limited number of tickets may be available at the registration desk for those who did not pre-register.

Wednesday Evening Social - A social with cash bar will be held in the Alumni Center on the NLU campus from 7:30-10:00 p.m. Music will be provided by guitarist Marcus Chapman of the NLU Music Department. Shuttle service will be provided between NLU and the Holiday Inn Holidome.

Thursday Evening Fais Do-Do/Crawfish Fête - The Thursday evening gathering will be held from 6:30-10:30p.m. at NLU's Layton Farm Pavilion east of campus on US Hwy. 80. On the menu will be "all you can eat" boiled crawfish, cochon de lait stuffed with smoked sausage (imported from Ville Platte), pasta salad (vegetarian), beer and other refreshments, and live music provided by Steve Riley and the Mamou Playboys. Shuttle service will be provided from the Holiday Inn Holidome, the Holiday Inn Atrium, Budget Inn and Travelodge Mid-City. Guests of the Stratford House Inn and La Quinta will be served at the Holidome shuttle stop. No private vehicles will be admitted to the event.

Friday Evening Banquet - The ASB Banquet will be held from 6:30-8:30p.m. in Schulze Dining Hall on the NLU campus. There will be a choice of a chicken, beef or vegetarian entree.

Friday Evening Wind Down -Immediately following the banquet in Schulze Dining Hall, 8:30-10:00, will be a final social gathering featuring the music of Amanda Dark and Enough Said. Amanda is the 1996 Grand Champion Louisiana State Fiddler and a student at NLU. She and her band will be playing classic and contemporary bluegrass to help us enjoy a final evening with our friends and colleagues. Free beer will be available to all banquet attendees if further relaxation is desired. Shuttle service will be provided as on Thursday evening.

Field Trips - All field trips depart from the Holiday Inn Holidome parking lot. Details on each trip are available in the January *ASB Bulletin* and on the web site (www.nlu.edu/asb).

Local Arrangements Committee (area code 318)

Local Arrangements:	 Kim Tolson	342-1805; bitolson@alpha.nlu.edu
Program:	 Frank Pezold	342-1794; bipezold@alpha.nlu.edu
Social Arrangements:	 Robyn Jordan	342-1946; bijordan@alpha.nlu.edu
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	 Kelby Ouchley	726-4400; kelby_ouchley@mail.fws.gov
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	 Steve Hecht	342-1802; bihecht@alpha.nlu.edu
	 Tom Sasek	342-1792; bisasek@alpha.nlu.edu

ASB CANDIDATES FOR OFFICE - 1998

The nominating committee, composed of Chair, Jim Ross and Rebecca Sharitz, has selected the following slate of nominees for the ASB offices to be filled in 1998. Additional nominations will be received from the floor. *Voting will take place at the annual business meeting at 11:30 AM, Friday, 17 April 1998. Please plan to attend.*

President Elect: **Diane Nelson**

East Tennessee State University
Johnson City, Tennessee

Pat Parr

Oak Ridge National Laboratory
Oak Ridge, Tennessee

Vice President: **Beverly Collins**

Savannah River National Laboratory
Aiken, South Carolina

Robert Haynes

The University of Alabama
Tuscaloosa, Alabama

Executive

John Aho

Auburn University at Montgomery
Montgomery, Alabama

Committee:

George Cline

Jacksonville State University
Jacksonville, Alabama

A. Joseph Pollard

Furman University
Greenville, South Carolina

David D. Taylor

USDA Forest Service
Daniel Boone National Forest, Kentucky

PRESIDENT-ELECT

Diane Nelson



Pat Parr



Diane R. Nelson - Dr. Nelson is Professor of Biological Sciences at East Tennessee State University, Johnson City, Tennessee. In 1993, she received the ETSU Distinguished Faculty Award, the university's highest award for achievements in teaching, research, and service.

A native Tennessean, she attended school in Oak Ridge and Knoxville. At the University of Tennessee-Knoxville, she earned a B.S. degree in Secondary Education (Natural Science), and the M.S. and Ph.D. degrees in Zoology, with the assistance of an NSF Research Assistantship and NASA Traineeship. Her dissertation on the tardigrades (water bears) of Roan Mountain led to an invitation to present her research at the First International Symposium on the Tardigrada, held in Italy in 1974. Dr. Nelson organized the 3rd International Symposium on the Tardigrada at ETSU in 1980 and the 5th Symposium in conjunction with the 8th International Meiofauna Conference at the University of Maryland, 1992. Dr. Nelson and her students have continued to conduct research on the ecology and systematics of tardigrades, collaborating with colleagues in the U.S. and Europe.

In addition to her interest in invertebrates, Dr. Nelson developed a passion for marine biology and underwater photography in 1980. She enrolled in courses at the Bermuda Biological Station for Research and other marine biological stations in Puerto Rico, Texas, and Georgia. As a result, Dr. Nelson teaches marine biology and invertebrate zoology at ETSU, and she has led students on field trip courses to Bermuda, the Bahamas, Australia's Barrier Reef, and Bonaire. After teaching Chautauqua short courses for college teachers at the Bermuda Biological Station for several years, she now teaches college students and faculty in the summer program at the Harbor Branch Oceanographic Institution in Ft. Pierce, FL. Recently she has studied whale sharks in the Sea of Cortez and sand tilefishes in Belize, the Red Sea, and the Solomon Islands with Dr. Eugenie Clark (National Geographic's "shark lady"). Her husband, Dr. Jack L. Nelson, is a Ph.D. chemical engineer recently retired from Eastman Chemical Company. He has done extensive underwater videography on many of the trips and serves as an adjunct professor in the Department of Biological Sciences at ETSU.

A Fellow of the Tennessee Academy of Science, Dr. Nelson received the Distinguished Service Award in 1992 for serving as Secretary for fourteen years, and she was elected as President of the organization for 1995. She is also the current Program Officer for the American Microscopical Society as well as the TEAMS Chapter Representative to the National Marine Educators Association. Active as a long-time member of the Association of Southeastern Biologists, Dr. Nelson has presented papers, chaired the invertebrate zoology section, served as Vice-President (1991-1992), Executive Committee member (1987-1990), member of the Conservation Committee, and member and chair of both the Research Awards Committee and the Meritorious Teaching Award Committee.

Pat Parr, an active ASB member since 1978, has made numerous paper and poster presentations, chaired sessions, served as ASB Treasurer, Vice President, Chair of the Committee on Patron Members and Exhibitors, and is currently Chair of the Committee on Women, Minorities, and the Disabled. A researcher in the Environmental Sciences Division of Oak Ridge National Laboratory since 1974, she is currently Area Manager at Oak Ridge National Laboratory with responsibility for natural resource management, land use planning, and the National Environmental Research Park. Pat received her B.S. in Biology (1974) from Tennessee Wesleyan College, Athens, TN and her M.S. in Ecology (1981) from The University of Tennessee, Knoxville. She serves on the Oak Ridge Reservation Resource Management Council, represents Oak Ridge on the Public Affairs Committee of the Southern Appalachian Man and the Biosphere Cooperative, and is the Oak Ridge Biosphere Reserve manager. Pat received special recognition for her development of the Ecological and Physical Sciences Study Center, a precollege education program at Oak Ridge National Laboratory. She has published numerous articles of her research on chromium and plant uptake, as well as about the rare plants on the reservation.

VICE PRESIDENT

Beverly Collins - Dr. Collins is an Associate Research Ecologist at the Savannah River Ecology Laboratory, Aiken, South Carolina. She received her B.S. degree in Botany from the University of Kentucky in 1977, M.S. in Botany from Rutgers University in 1979, and Ph.D. in Botany and Plant Physiology from Rutgers in 1985. Following a postdoctoral appointment at the Savannah River Ecology Laboratory, where she studied old-field succession, she joined the faculty of Memphis State University as an Assistant Professor of Biology. In 1993, she returned to Savannah River Ecology Laboratory as an Associate Research Ecologist. She has served ASB as Secretary, as a member and chair of the ASB Committee on Women, Minorities, and Disabled Persons, and as a member of the BSA Activities Committee. She is a member of the Ecological Society of America, the British Ecological Society, the International Association of Vegetation Science, and the Torrey Botanical Society. She is presently serving as editor-in-chief of the *Journal of the Torrey Botanical Society*, while continuing to pursue research in vegetation dynamics. Currently, she is studying the effects of canopy gap size and mammalian herbivory on oak regeneration in bottomland hardwood forests, the dynamics of fire-maintained sandhills vegetation, and the population dynamics of two threatened plant species. Other interests include the philosophy of ecology and the art of weaving.

Robert R. Haynes - Dr. Haynes is Professor of Biological Sciences at The University of Alabama, Tuscaloosa, Alabama. He earned his B.S. in Botany from Louisiana Polytechnic Institute (Louisiana Tech University), his M.S. in Biology from The University of Southwestern Louisiana, and his Ph. D. in Botany from The Ohio State University. Haynes taught two years at Louisiana State University in Shreveport before moving to Alabama. His research interests are in the systematics of aquatic vascular plants. Techniques utilized for his systematic studies include morphology, phytogeography, ecology, cytology, phytochemistry, and, more recently, chloroplast DNA sequences. Haynes has been an active member of ASB since 1977 and has served the Association in several capacities. He currently serves on the Executive Committee. In addition, he is a long time member of the International Association of Plant Taxonomists, American Society of Plant Taxonomy, Botanical Society of America, and Southern Appalachian Botanical Society. He has served on one or more committees for all of the above organizations except the IAPT. In addition, he was elected as a Fellow of the Linnean Society of London in 1987. Haynes has authored one book and more than 60 publications in scientific journals. He also has prepared one or more aquatic families for many floras, ranging from the American tropics to North America. His research has been funded by several sources, but mostly by the National Science Foundation, from which he has received more than six grants. Haynes is the program director for SERFIS, a computer database that when complete will house label data for most herbarium specimens stored in herbaria of the Southeastern United States.

EXECUTIVE COMMITTEE

John M. Aho - Dr. Aho is an Associate Professor in the Department of Biology, Auburn University at Montgomery, Montgomery, AL. He earned his B.A. at Wake Forest University, a M.A. in Zoology/Parasitology from Wake Forest University, and a Ph.D. in Aquatic Ecology/Parasitology from the University of Exeter, England. His research interests are in the ecology and evolution of host-parasite interactions, population and community dynamics of wetland invertebrates and fishes, and stream ecology. Dr. Aho has been an active member in a number of societies including the Ecological Society of America, American Society of Ichthyologists and Herpetologists, North American Benthological Society, and American Society of Parasitologists. He has served on the SE-ESA E.P. Odum Student Paper Competition

Committee (3 years, current chair), ASB Poster Competition Committee, and is the ASB Executive Committee representative from the Southeastern Society of Parasitologists (4 years). He is also the current President of the Southeastern Society of Parasitologists. In addition, Dr. Aho is active in community environmental programs, such as providing technical expertise and educational outreach activities for local schools associated with a local watershed restoration project. He is also active with the Alabama WaterWatch, a volunteer water quality monitoring program in AL.

George Cline - Dr. Cline is an Associate Professor of Biology at Jacksonville State University. He earned his B.S. at Indiana University of Pennsylvania in Biology, and Environmental Health, and his Ph.D. in Zoology at Oklahoma State University. His research interests are in frog communication systems, biology and conservation of amphibians and reptiles, and application of satellite technologies to environmental assessment. George has received funding from several sources including NASA EPSCoR, USFWS, DOD, NRCS, Hawk Mountain Sanctuary Association, and JSU Faculty Research Committee. George is the Remote Sensing Co-Cluster leader for the Alabama Space Grant EPSCoR grant. He served on the ASB Graduate Student Support Award Committee (94-97) and currently serves on the Poster Awards Committee, is currently the SEASIH Vice-President, and he is active in the Alabama Herpetological Society. George is active in undergraduate student research and serves as the chairman of the JSU Student Research Symposium Committee. His students have given talks at ASB, the Alabama Academy of Science, the Alabama Herpetological Society, and the Society for the Study of Amphibians and Reptiles. In addition, George is active in community education programs such as the Little River Canyon Field School, and as co-sponsor of the HerpFest series with the Anniston Museum of Natural History.

A. Joseph Pollard - Dr. Joe Pollard is Professor of Biology at Furman University in Greenville, SC. He received a B.S. in Botany at Duke University in 1977, and a Ph.D. in Botany at Cambridge University in England, in 1981. Prior to assuming his current position in 1988, he was a faculty member at Oklahoma State University. Dr. Pollard's research concerns plant evolutionary ecology, in particular the interactions of plants with herbivores and with heavy metals in soils, with a recent emphasis on the possible defensive role of metal hyperaccumulation in European members of the Brassicaceae. This work has implications for the bioremediation of metal-polluted soils, and in these areas he maintains an active collaboration with the University of Sheffield in England. His undergraduate research students have published and presented on studies of this system, as well as many projects involving the flora of the Southeast. Joe is director of the S.A. Ives Herbarium at Furman University, teaches courses in Ecology, Field Botany, Biostatistics, and Introductory Biology, and has led field courses in New England, Canada, the Pacific Northwest, Costa Rica, and Ecuador/Galapagos. He was the program chair of the 1997 ASB meetings hosted by Furman, and currently serves on the ASB Resolutions Committee and Place of Meetings Committee. He is also a member of ESA, BSA, and SABS.

David D. Taylor earned his B.A. in biology/agriculture from Berea College. He earned his Masters in Biology (Botany emphasis) from Northeast Louisiana University. Following two years of teaching duties at Cumberland College (KY), he took a position with USDA Forest Service. He has served as Forest Botanist/Ecologist, Daniel Boone National Forest, Kentucky since 1989. David belongs to numerous professional societies including Sigma Xi, SABS, NEBC, ASPT, Kentucky Academy of Sciences (KAS) Natural Areas Association, and ASB. He has served as Botany-Microbiology Section Chair and Secretary for KAS and is currently Chair of the Conservation Committee for ASB.

PLENARY SPEAKER

Dr. Leslie Real
Asa Griggs Candler Professor of Biology
Emory University, Atlanta, Georgia

Dr. Real received his Ph.D. in 1977 from the University of Michigan where he worked with John Vandermeer on theories of foraging and behavioral aspects of predation. After graduating from Michigan, he accepted a Rosenstiel Postdoctoral Fellowship from the University of Miami. While at Miami, he first began exploring the role of uncertainty in shaping behavioral responses and the implications or variability in fitness components on evolutionary processes. In 1979 he moved to North Carolina State University where he remained until 1990 and continued working on ecological and evolutionary implications of uncertainty. In 1990, he joined the faculty of the Department of Biology at the University of North Carolina at Chapel Hill and in 1992 moved to Indiana University in Bloomington. While at Indiana, Dr. Real began expanding his research interests into the emerging field of disease ecology. His present research explores the effect of spatial heterogeneity and genetic variation on the dynamics of plant-pathogen interactions and the implications of different transmission modes on the evolution of virulence in RNA viruses. This year, Dr. Real moved to Emory University where he is Asa Griggs Candler Professor of Biology. He hopes to establish a new Center for Disease Ecology at Emory in close collaboration with the CDC.

Dr. Real has served the ecological community in a variety of ways. He has served on the editorial boards of *Ecology* and *Ecological Monographs*, *Oecologia*, *The American Naturalist*, and *Evolutionary Ecology*. He has served on many national committees, including the ESA's Sustainable Biosphere Initiative Committee, and co-chaired (with Jim Brown) the 75th Anniversary Book Committee of the ESA that produced *Foundations of Ecology* (Univ. Chicago Press). He has been Vice-president of the American Society of Naturalists, and recently completed a three year appointment to the Board on Environmental Studies and Toxicology (BEST) at the National Research Council. He currently is a consultant to the Science Advisory Board of the EPA. In 1996, Dr. Real was a Scholar in Residence at the Rockefeller Foundation's Bellagio Study Center in Italy where he began work with Andrew Dobson on a text book on Disease Ecology and Evolution.

PROGRAM SUMMARY

All events will be held on the NLU campus and at the Holiday Inn Holidome. See campus map and Nursing (Nurs) Building floor plan in this issue of the *Bulletin*.

WEDNESDAY, APRIL 15, 1998

8:30a.m.-1:00p.m.	Copenhagen field trip departs from the parking lot of the Holiday Inn Holidome at 8:30a.m. See January 1998 <i>ASB Bulletin</i> or web site (www.nlu.edu/asb) for details.
12:00p.m.-5:00p.m.	Registration, Lobby, Holiday Inn Holidome
3:00p.m.-7:00p.m.	ASB Executive Committee Meeting, Bourbon Room, Holidome
4:00p.m.-5:00p.m.	SFC Technical Advisory Committee Meeting, Acadian Room, Holidome
4:00p.m.-7:00p.m.	SABS Council Meeting, St. Charles Room, Holidome
7:30p.m.-10:00p.m.	ASB Social (cash bar), <i>Alumni Center</i>
8:00p.m.-10:00p.m.	Continuation of ASB Executive Committee Meeting (if needed), <i>Bourbon Room, Holidome</i>

THURSDAY, APRIL 16, 1998

7:00a.m.-8:00a.m.	Past Presidents' Breakfast, Acadian Room, Holidome
7:00a.m.-8:30a.m.	Poster Set-Up, <i>Nursing Third Floor Hallway</i>
8:00a.m.-5:00p.m.	Registration, Nursing Foyer
8:00a.m.-5:00p.m.	Slide Preview, <i>Nurs 215</i>
8:30a.m.-10:00a.m.	Plenary Session, Nursing Auditorium
10:00a.m.-5:00p.m.	Commercial Exhibits, Nurs 325
10:00a.m.-11:00a.m.	Workshop Sponsored by ASB Committee on Women, Minorities and the Disabled, and the ESA/SE Chapter, Nurs 343A
10:00a.m.-5:00p.m.	Poster Session (Presenters with posters 10:00-11:30), <i>Nursing Third Floor Hallway</i>

Morning Paper Sessions

11:00a.m.-12:00p.m.	Plant Ecology, <i>Nurs 338</i>
11:00a.m.-12:00p.m.	Plant Systematics, <i>Nurs 340</i>
11:00a.m.-12:00p.m.	Aquatic Ecology, <i>Nurs 339</i>
11:00a.m.-12:00p.m.	Cellular/Molecular Biology and Genetics, <i>Nurs 321</i>
11:00a.m.-12:00p.m.	Fish Ecology, <i>Nurs 322</i>

Luncheon Meeting

12:15p.m.-1:45p.m. **Society of Wetland Scientists and Consortium for Research on Southern Forested Wetlands, Gold Room, Coenen Cafeteria**

Afternoon Paper Sessions

1:30p.m.-2:30p.m. Animal Ecology, *Nurs 321*
 1:30p.m.-5:30p.m. Plant Ecology, *Nurs 338*
 1:30p.m.-3:45p.m. Plant Systematics, *Nurs 340*
 1:30p.m.-4:45p.m. Aquatic Ecology, *Nurs 339*
 1:30p.m.-2:45p.m. Genetics, *Nurs 242*
 1:30p.m.-3:30p.m. Fish Ecology, *Nurs 322*
 2:45p.m.-3:45p.m. Environmental Microbiology, *Nurs 321*
 3:00p.m.-5:00p.m. Evolution, *Nurs 242*

Business Meetings

4:00p.m.-4:30p.m. **American Society of Ichthyologists and Herpetologists, SE Division, Nurs 340**
 4:00p.m.-6:00p.m. **Herbarium Curators Meeting, Stubbs 244**
 4:30p.m.-5:30p.m. **Southeastern Fishes Council, Nurs 340**

Special Events

6:30p.m.-10:30p.m. **ASB Fais Do-Do and Crawfish/Cochon de Lait Fête, Layton Farm**

FRIDAY, APRIL 17, 1998

7:00a.m.-8:30a.m. **Breakfast and Business Meeting, Southern Appalachian Botanical Society and SE Section, Botanical Society of America, New Orleans Room, Holidome**
 8:00a.m.-12:00p.m. **Registration, Nursing Foyer**
 8:00a.m.-12:00p.m. **Commercial Exhibits, Nurs 325**
 8:00a.m.-5:00p.m. **Slide Preview, Nurs 215**
 8:00a.m.-5:00p.m. **Poster Session, Nursing Third Floor Hallway**
 8:00a.m.-5:00p.m. **Beta Beta Beta Book Display, Nurs 343A**

Morning Paper Sessions

8:00a.m.-10:00a.m. Invertebrate Zoology, *Nurs 322*
 8:00a.m.-11:00a.m. Beta Beta Beta, *Nurs 339*

8:00a.m.-11:30a.m.	ESA Symposium: Bottomland Hardwood Restoration, <i>Nurs 338</i>
8:00a.m.-10:15a.m.	Herpetology, <i>Nursing Auditorium</i>
9:00a.m.-10:00a.m.	Fish Ecology, <i>Nurs 242</i>
9:15a.m.-11:30a.m.	Plant Systematics I, <i>Nurs 340</i>
9:15a.m.-10:15a.m.	Plant Systematics II, <i>Nurs 321</i>
10:15a.m.-11:15a.m.	Animal Physiology, <i>Nurs 322</i>
10:30a.m.-11:30a.m.	Ichthyology, <i>Nursing Auditorium</i>

Business and Luncheon Meetings

11:00a.m.-12:00p.m.	Beta Beta Beta Business Meeting, <i>Nurs 339</i>
12:00p.m.-1:30p.m.	Beta Beta Beta Luncheon, <i>Schulze Dining Hall</i>
11:30a.m.-12:30p.m.	ASB Business Meeting and Election of Officers, <i>Nursing Auditorium</i>
12:30p.m.-2:00p.m.	Ecological Society of America, SE Chapter, Luncheon and Business Meeting, <i>Gold Room, Coenen Cafeteria</i>

Afternoon Paper Sessions

1:30p.m.-4:30p.m.	Beta Beta Beta, <i>Nurs 339</i>
1:30p.m.-4:30p.m.	Beta Beta Beta, <i>Nurs 242</i>
1:30 p.m.-4:30p.m.	Beta Beta Beta, <i>Nurs 243</i>
1:30p.m.-3:00p.m.	Ichthyology, <i>Nursing Auditorium</i>
2:00p.m.-5:15p.m.	Plant Ecology, <i>Nurs 340</i>
2:00p.m.-5:00p.m.	ESA Symposium: Bottomland Hardwood Restoration, <i>Nurs 338</i>
2:00p.m.-2:45p.m.	ASB Teaching Seminar: Biotechnology Education: Laboratory Applications, <i>Nurs 322</i>
2:45p.m.-3:45p.m.	Teaching Biology, <i>Nurs 322</i>
3:15p.m.-4:45p.m.	Herpetology, <i>Nursing Auditorium</i>

Special Events

6:30p.m.-8:30p.m.	ASB Banquet and Awards, <i>Schulze Dining Hall</i>
8:30p.m.-10:00p.m.	Social Wind Down, <i>Schulze Dining Hall</i>

SATURDAY, APRIL 18, 1998

8:00a.m.-10:00a.m.	ASB Executive Committee Breakfast Meeting, Acadian Room, Holidome
7:00a.m.-1:30p.m.	Field Trips depart from the Holiday Inn Holidome parking lot. See January 1998 <i>ASB Bulletin</i> or web site (www.nlu.edu/asb) for details.

ASB PAPER AND POSTER SESSIONS

Thursday Morning, April 16, 1998

**Plenary Session - Nursing Auditorium
8:30a.m.-10:00a.m.**

Lawson Swearingen, President, Northeast Louisiana University. Welcoming remarks.

J. Whitfield Gibbons, ASB President. Response.

Leslie Real, Emory University. Invited plenary speaker.

POSTERS - Nursing Third Floor Hallway

Posters displayed 10:00a.m.-5:00p.m. April 16, 8:00a.m.-5:00p.m. April 17.

Presenters with posters 10:00a.m.-11:30a.m, Thursday, April 16.

- 1 **Beddingfield, Steven D. and James B. McClintock.** (University of Montevallo and University of Alabama at Birmingham) Growth, reproduction and population characteristics of *Lytechinus variegatus* from three contrasting habitats.
- 2 **Gatewood, Melissa.** (Furman University) An investigation of distribution patterns in 31 freeze-branded bottlenose dolphins (*Tursiops truncatus*) along the North Carolina coast using photo-identification techniques.
- 3 **Peters, Jeffrey L. and Gwenda L. Brewer.** (Frostburg State University) Pursuit flight activity of male Gadwall (*Anas strepera*).
- 4 **Harper, Erika, Catherine Hunter, Irene Kokkala and Dennis Haney.** (Furman University and North Georgia College and State University) The effects of salinity on chloride cell proliferation in *Cyprinodon variegatus*.
- 5 **Devinney, Patricia, E.J. Davis and Donald Sparling.** (Bowie State University and Patuxent Wildlife Research Center) Assessing restored depressional wetlands in the mid-Atlantic states.
- 6 **Lancaster, David A. and Terry Richardson.** (University of North Alabama) Distribution and abundance of non-chironomid insects in a freshwater wetland.
- 7 **Lockhart, Brian, R. James E. Kellum, Lynne C. Thompson, Philip A. Tappe, David G. Peitz, Robert C. Weih, Jr., Edmond J. Bacon and Hal O. Leichty.** (University of Arkansas, Monticello) Impacts of reproduction cutting methods in a bottomland hardwood ecosystem: a multidisciplinary study.

- 8 **Robertson, Mike S. and Kirk Winemiller.** (Texas A&M University) Effect of an introduced piscivore on the native fish assemblage in the Devil's River, Texas.
- 9 **Betts, Tashaun C., E.J. Davis and Keang Peng Song.** (Bowie State University and National University of Singapore) Characterizing the genetic differences among pathogenic and non-pathogenic strains of *Clostridium difficile*.
- 10 **Dhawan, Vijender and Diane S. Swaffar.** (Northeast Louisiana University) Correlation between altered topoisomerase II enzymatic activity and phenotypic changes associated with cancer cells.
- 11 **Doucet, John P., Meg DeAngelis, Z. Den, Stacy Drury, Mark Batzer, Bronya J. Keats and Precott L. Deininger.** (Nicholls State University and LSU Medical Center, New Orleans) Gene discovery in Acadian Usher Syndrome.
- 12 **Flickinger, Shane T. and William L. Seddon.** (Frostburg State University) Long term maintenance of *in vivo* function in cultured channel catfish hepatocytes.
- 13 **Leong, Laurel L. Y., Kenneth G. Wilson and Nancy L. Smith-Huerta.** (Miami University) A comparison of gene expression between wild-type *Clarkia tembloriensis* and the one-whorl homeotic mutant, *crinkled petal*.
- 14 **Yamashita, Tsunemi and Jian Qin.** (Northeast Louisiana University) PCR detection of *Mycobacterium leprae* in the armadillo, *Dasypus novemcinctus*.
- 15 **Dover, Shannon L., Sarah M. Kath, D.K. Kennedy and Mazin B. Qumsiyeh.** (Furman University, Duke University and University of Memphis) Robertsonian polymorphism in western Tennessee populations of *Blarina carolinensis*: not all translocations are deleterious.
- 16 **Stanton, Kathleen and William L. Seddon.** (Frostburg State University) Combined effects of dietary lipids and environmental temperature on growth, protein and lipid composition of channel catfish (*Ictalurus punctatus*) fingerlings.
- 17 **Grayson, Jackie and Ann M. Findley.** (Northeast Louisiana University) Parasitemia in turtles from northeast Louisiana.
- 18 **Booth, Robert K. and John Averett.** (Georgia Southern University) Causes of *Quercus virginiana* decline and recommendations for management at Fort Stewart Military Base, GA
- 19 **Conner, William H. and L. Wayne Inabinette.** (Baruch Forest Science Institute) Response of three forested wetland species to flooding and competition.

- 20 **Hinkle, C. Ross, Duane DeFreese, Paul A. Schmalzer, David Cox, Randy Parkinson, Margaret Hames and Anne Birch.** (Environmentally endangered Lands Program, Brevard County, Florida) From land acquisition to management, a local conservation program matures.
- 21 **Kelly, K.A., K.K. Denley, S.P. Faulkner and R.A. Stewart.** (Delta State University) Woody thicket community composition and structure at abandoned tenant house sites in the Yazoo-Mississippi Delta floodplain.
- 22 **Langley, Susan K., Karen Humes and Heather Cheshire.** (North Carolina State University and University of Oklahoma) A comparison of single date and multitemporal satellite image classifications in a semi-arid grassland.
- 23 **Ritchie, Jerry C., Brean W. Duncan, Dave R. Breininger and C. Ross Hinkle.** (USDA-ARS Hydrology Laboratory and The Dynamac Corporation) Application of airborne laser altimetry to measure vegetation properties at Kennedy Space Center, Florida.
- 24 **Trisel, Donald E. and David L. Gorchov.** (Fairmont State College and Miami University) Competitive effects of an invasive ornamental shrub, *Lonicera maackii*, on *Acer saccharum* seedlings.
- 25 **Farmer, Susan B. and Edward E. Schilling.** (University of Tennessee at Knoxville) Toward an understanding of the global phylogeny of the Trilliaceae.

WORKSHOP- Nurs 343A

Sponsored by ASB Committee on Women, Minorities and the Disabled,
and the Ecological Society of America, Southeastern Chapter

- 10:00 **Lynda Lewis.** (Stevens and Lewis Associates) Diversity: Building Communication Skills to Enhance Understanding.

PLANT ECOLOGY - Nurs 338

Presiding: *Linda E. Watson*, Miami University

- 11:00 26 **Battaglia, Loretta L. and Rebecca R. Sharitz.** (Savannah River Ecology Laboratory) Disturbance increases environmental heterogeneity in a southeastern floodplain forest.
- 11:15 27 **Cushman, Laary J. and Harry E. Shealy, Jr.** (University of South Carolina, Aiken) Tree ring studies of *Taxodium distichum* L. and the effects of different community types upon their growth rates.

- 11:30 28 **Allen, Bruce P., Eric F. Pauley and Rebecca R. Sharitz.** (Savannah River Ecology Laboratory and Coastal Carolina University) Long-term hurricane influences on liana community structure in a southeastern floodplain forest.
- 11:45 29 **Whitbeck, Julie L., J. Barmore, M.D. King and B. Stevens.** (Tulane University) Impacts of soil-based refinery pollutants on bottomland hardwood forests: responses at organism, population and community levels of organization.

PLANT SYSTEMATICS- *Nurs 340*

Presiding: *Kathleen Hornberger*, Widener University

- 11:00 30 **Bailey, Pamela and Dan K. Evans.** (Marshall University and Catholic University, Quito) A medicinal plant survey in public market places of Ecuador.
- 11:15 31 **Allen, Charles, Joe Saunders, Maraya Gullette and Monica Barrois.** (Northeast Louisiana University) Identification of seeds from the Watson Brake mound complex in northeast Louisiana.
- 11:30 32 **Fleming, Chris A., Ralph L. Thompson and Rudy A. Gelis.** (Berea College) Wetland and aquatic vascular flora of five reservoirs in the Berea College Forest, Madison and Jackson Counties, Kentucky.
- 11:45 33 **Thompson, Ralph L. and Johnny R. Skeese.** (Berea College and University of Toledo) Vascular flora of Golden and Silver Falls State Park, Coos County, Oregon

AQUATIC ECOLOGY - *Nurs 339*

Presiding: *Jeff Jack*, Western Kentucky University

- 11:00 34 **Martz, Tara E. and David A. Francko.** (Miami University) Primary productivity at the Old Woman Cree National Estuarine Research Reserve, Huron, OH.
- 11:15 35 **Clyde, Gerard A., Jr., Jessica Franks and David A. Rolbiecki.** (University of North Texas) Spatial and temporal variability of chlorides and sulfates in Lake Texoma.
- 11:30 36 **Kalinsky, Robert G.** (Louisiana State University in Shreveport) Limnological investigations of a mesoeutrophic lake in northwestern Louisiana.
- 11:45 37 **Kelley, Randall, and Jeff Jack.** (Western Kentucky University) Temporal variation in water chemistry parameters in a karst wetland.

CELLULAR/MOLECULAR BIOLOGY AND GENETICS - Nurs 321

Presiding: *Dwayne Wise*, Mississippi State University

- 11:00 38 **Jin, Eun-Jung and Giselle Thibaudeau.** (Mississippi State University) Signal transduction events involved in the pigmentation of the embryonic zebrafish.
- 11:15 39 **Coggin, Steven J.** (Catawba College) Dynamic complexity in *Physarum polycephalum* shuttle streaming.
- 11:30 40 **Varner, Chelsia L, E.J. Davis and Su-Shu Pan.** (Bowie State University and Greenbaum Cancer Center) Molecular cloning of the Ku-70 and Ku-86 subunits of DNA Helicase II from human cells.
- 11:45 41 **Kupfer, Holly and Dwayne Wise.** (Mississippi State University) Nonrandom segregation of the sex univalents in the flea beetle, *Alagoasa bicolor*.

FISH ECOLOGY - Nurs 322

Presiding: *Henry L. Bart*, Tulane University

- 11:00 42 **Lewis, Bradley R., K. Jack Killgore and Jan Jeffrey Hoover.** (DynTel Corporation and U.S. Army Engineer Waterways Experiment Station) Chronology of larval fish abundance in the floodplain of a regulated river system.
- 11:15 43 **Anderson, Allison A.** (Texas A&M University) Reproductive and population differences between tailwater and non-tailwater orangethroat darters in central Texas.
- 11:30 44 **Backer, Jennifer and Mark Schorr.** (University of Tennessee at Chattanooga) Abundance and structure of centrarchid assemblages in backwater and main channel border habitats of Nickajack Reservoir, Tennessee.
- 11:45 45 **Ensign, William E. and Paul L. Angermeier.** (Kennesaw State University and Virginia Tech) Factors influencing stream fish recovery following a large-scale disturbance.

Thursday Afternoon, April 16, 1998**ANIMAL ECOLOGY - Nurs 321**

Presiding: *Richard Buchholz*, Northeast Louisiana University

- 1:30 46 **Smee, Delbert L., Jonathan Copeland and Daniel V. Hagan.** (Georgia Southern University) Behavior of Nantucket pine tip moths and *Hyssopus rhyacioniae*, its primary parasitoid in the Coastal Plain of Georgia.
- 1:45 47 **Wallace, Monica and Richard Buchholz.** (Northeast Louisiana University) Cross-fostering of red-cockaded woodpecker nestlings: preliminary results.
- 2:00 48 **Corley, J. Brian.** (North Georgia College and State University) Reintroduction history and observations of a mated pair of Southern Bald Eagles (*Haliaeetus leucocephalus leucocephalus*) and their fledged young of the year.
- 2:15 49 **Hulsey, Bannie C., Daniel V. Hagan and C. Wayne Berisford.** (Georgia Southern University and University of Georgia) Edge effects and their influence on distribution of Nantucket pine tip moths and their parasitoids.

ENVIRONMENTAL MICROBIOLOGY - Nurs 321

Presiding: *Jerald D. Hendrix*, Kennesaw State University

- 2:45 50 **Tennant-Clegg, Esther P. and Jerald D. Hendrix.** (Kennesaw State University) Characterization of bacteria responsible for background anomalies in the quantitation of fecal coliform bacteria by the membrane filter technique.
- 3:00 51 **Spratt, Henry G., Jr. and Michael G. Weathersby.** (University of Tennessee at Chattanooga) Sulfur transformations in surface soils of the Tennessee River Gorge.
- 3:15 52 **Bergin, Jaron J., Henry G. Spratt, Jr. and Doug Fritz.** (University of Tennessee at Chattanooga and City of Chattanooga) Monitoring fecal coliform in stormwater discharge in order to identify nonpoint source pollution.
- 3:30 53 **Spratt, Henry G., Jr. and Kristen B. Howerton.** (University of Tennessee at Chattanooga) Carbon and sulfur transformations in A-horizon soils of the Missouri Ozark Forest Ecosystem Project one year post-harvest.

PLANT ECOLOGY - Nurs 338

Presiding: *Keith Ouchley*, Louisiana State University

- 1:30 54 **Smith, Peter and Gary L. Walker.** (Appalachian State University) A vegetational characterization of cliff face communities in the Linville Gorge Wilderness Area.
- 1:45 55 **Robertson, Philip A. and Mark Basinger.** (Southern Illinois University) Characteristics of coarse woody debris in two old-growth forests in southern Illinois.
- 2:00 56 **Fletcher, Tara S. and John L. Vankat.** (Miami University) Understanding old-growth forests of south-central Alaska: herbaceous species.
- 2:15 57 **Hitchcock, Stephanie L., A. Joseph Pollard and Katherine J. Elliott.** (Furman University and USDA Forest Service, Coweeta Hydrologic Laboratory) Effects of catastrophic windthrow followed by salvage logging on herbaceous layer species in the southern Appalachians.
- 2:30 58 **Horn, Charles N., Jonathan Williams and C. Clinton Harshaw.** (Newberry College) A preliminary study of soils and vegetation on floodplains in the Piedmont of South Carolina.
- 2:45 59 **Ulrey, Christopher J. and Thomas R. Wentworth.** (North Carolina State University) A comparison of Detrended Correspondence Analysis and Nonmetric Multidimensional Scaling using three southern Appalachian data sets.
- 3:00 60 **McLeod, Kenneth W. and John E. Pinder III.** (Savannah River Ecology Laboratory) The relationships of multitemporal drought stress indicators from Thematic Mapper data to measured growth effects in longleaf pine plantations.
- 3:15 **BREAK**
- 3:30 61 **Tuberville, Tracey D.** (Savannah River Ecology Laboratory) Effects of soil disturbance by gopher tortoises (*Gopherus polyphemus*) on vegetation in the longleaf pine-wiregrass ecosystem.
- 3:45 62 **Booth, Robert K. and Fredrick J. Rich.** (Georgia Southern University) Holocene vegetation history and paleoecology of Beach Pond, St. Catherines Island, Georgia.

- 4:00 63 **Basinger, Mark A. and Philip A. Robertson.** (Southern Illinois University) Woody vegetation change following timber harvest in the Ozark Hills of southern Illinois.
- 4:15 64 **Phelps, Timothy R., James S. Fralish and Daniel R. Unger.** (Southern Illinois University) Comparison of pre-settlement and present vegetation cover of Marion County, IL using a geographic information system.
- 4:30 65 **Adams, Eric D., David J. Gibson, Joseph S. Ely, Danny J. Gustafson, Douglas N. McEwen and Tracy Evans.** (Southern Illinois University and Illinois Department of Natural Resources) Vegetation recovery over an 18 year period at a recreational facility.
- 4:45 66 **Shumway, Durland L. Joseph K. Schnatterly, Stephen A. Dinkelacker and Margaret T. Pantall.** (Frostburg State University) Spatial distribution of oak species in pre-settlement forest stands in western Maryland.
- 5:00 67 **Winstead, Joe E.** (Morehead State University) Pattern of recovery thirty-two years after clear-cutting of a hemlock forest in eastern Kentucky.
- 5:15 68 **Collins, B. and G. Wein.** (Savannah River Ecology Laboratory) Disturbance frequency and intensity effects on early oldfield succession.

PLANT SYSTEMATICS - Nurs 340

Presiding: **Patricia B. Cox**, University of Tennessee, Knoxville

- 1:30 69 **Basinger, Mark A. and Jody P. Shimp.** (Southern Illinois University and Illinois Department of Natural Resources) Status of *Silene ovata* Pursh in Illinois.
- 1:45 70 **Risk, Allen C. and Jack R. Ousley II.** (Morehead State University) Preliminary bryophyte and vascular flora of the Hog Hollow Seeps, Bath County, KY.
- 2:00 71 **Ramsey, Gwynn W.** (Lynchburg College) Plant diversity survey of the Peaks of Otter backcountry area, Blue Ridge Parkway, Virginia.
- 2:15 72 **Flagg, Raymond O. Gerald L. Smith and Walter S. Flory.** (Carolina Biological Supply Company, High Point University and Wake Forest University) Floral morphometric separation of southeastern species of *Zephyranthes*.
- 2:30 73 **Hyatt, Philip E.** (Kisatchie National Forest) Arkansas *Carex* Cyperaceae: a briefly annotated list.

- 2:45 74 **Stalter, Richard and Eric E. Lamont.** (St. John's University and New York Botanical Garden) Rare and endangered vascular flora of North Carolina's Outer Banks, Shackleford Banks, to Virginia.
- 3:00 75 **Bradley, Ted.** (George Mason University) Contributions to the flora of North Andros Island, Bahamas - Gobie Lake Blue Hole.
- 3:15 76 **Thomas, R. Dale and Herbert Young.** (Northeast Louisiana University) A checklist of the vascular flora of Ouachita Parish, Louisiana.
- 3:30 77 **Jones, Ronald L. and Charlie Lapham.** (Eastern Kentucky University and Kentucky Native Plant Society) Index Kentuckiensis, a new approach for the manipulation and mapping of specimen data.

AQUATIC ECOLOGY - Nurs 339

Presiding: *Robert G. Kalinsky*, Louisiana State University in Shreveport

- 1:30 78 **Watts, Tiffany and Mark Schorr.** (University of Tennessee at Chattanooga) Impacts of coal mine drainage on water quality and aquatic salamanders in a Cumberland Plateau stream.
- 1:45 79 **Lindsey, Kristen L., Robert A. Angus and Ken R. Marion.** (University of Alabama at Birmingham) Biological assessment of the effects of urbanization on an Alabama river using benthic macroinvertebrate populations.
- 2:00 80 **Freeman, Paul, Mark Schorr and Charles Nelson.** (University of Tennessee at Chattanooga) Comparative study of benthic macroinvertebrate assemblages in acid-polluted and reference streams in the North Chickamauga Creek system, Tennessee.
- 2:15 81 **Crews, Evan and Mark Schorr.** (University of Tennessee at Chattanooga) Potential of constructed wetlands to improve the water quality of acid mine drainage in the North Chickamauga Creek watershed, Tennessee.
- 2:30 82 **Hupp, Cliff R.** (U.S. Geological Survey) Woody debris, sedimentation and vegetation relations in a forested wetland along the Cache River, Arkansas.
- 2:45 83 **Matthews, Christopher R., E. Michael Wolfe and William Tingle.** (HDR Engineering, Inc. of North Carolina and Mecklenburg County Stormwater Services) Performance of eight Piedmont plant species for use in stream restoration and bioengineering at Toby Creek, Charlotte, NC.

3:00 **BREAK**

- 3:15 84 **Long, Jeannie and Mark Schorr.** (University of Tennessee at Chattanooga) Effects of acid drainage from coal mines on stream water quality and fish assemblages in the north Chickamauga Creek system, Tennessee.
- 3:30 85 **Kohnke, Laura L., Stephen P. Vives and David C. Rostal.** (Georgia Southern University) Effects of fish chemical and visual cues on behavior, growth, and age at metamorphosis of larval mole salamanders, *Ambystoma talpoideum*.
- 3:45 86 **Vessels, Nicole and Jeff Jack.** (Western Kentucky University) The impact of vertebrate predation on microinvertebrate communities in a temporary karst lake.
- 4:00 87 **Smith, Gregory A. and Terry D. Richardson.** (University of North Alabama) Population dynamics of *Viviparus subpurpureus* in a temporary riparian wetland.
- 4:15 88 **Brown, Bryan L., William E. Dobson and Robert P. Creed.** (Appalachian State University) Distribution and abundance of an aquatic symbiotic worm (Annelida: Branchiobdellidae) on two sympatric species of host crayfish (Arthropoda: Crustacea).
- 4:30 89 **Soulen, Heather L. and Frank Jordan.** (Georgia Southern University and Loyola University New Orleans) Distribution and habitat use of grass shrimp in the lower St. Johns River Basin, Florida.

GENETICS - Nurs 242

Presiding: *Linda R. Richardson*, Texas A&M University

- 1:30 90 **Tate, Natale and Dwayne Wise.** (Mississippi State University) The mechanism of mitosis in Chinese hamster ovary (CHO) cells undergoing division without prior replication.
- 1:45 91 **Edwards, Adrienne L. and Rebecca R. Sharitz.** (University of Georgia and Savannah River Ecology Laboratory) Clonal diversity and local genetic structure of *Sagittaria isoetiformes* (Alismataceae) along an environmental gradient.
- 2:00 92 **Wise, Dwayne, Silvia Martin and Pilar Arana.** (Mississippi State University and Universidad Complutense) In meiosis of a grasshopper species, B chromosomes alter the metaphase checkpoint.
- 2:15 93 **Heist, Edward J. and John R. Gold.** (Texas A&M University) DNA microsatellite frequency and allelic diversity in the sandbar shark, *Carcharhinus plumbeus*, and blacktip shark, *C. limbatus*.

- 2:30 94 **Turner, Thomas F. and John R. Gold.** (Texas A&M University) Population size? A case study of three classes of molecular markers surveyed in red drum (*Sciaenops ocellatus*) from the Gulf of Mexico.

FISH ECOLOGY - Nurs 322

Presiding: *Henry W. Robison*, Southern Arkansas University

- 1:30 95 **Thompson, Andrew R., J. Todd Petty and Gary D. Grossman.** (University of Georgia) The influence of abiotic and biotic factors on habitat use by longnose dace, *Rhinichthys cataractae*, at two spatial sites.
- 1:45 96 **Davin, William, Jodi Hodges, Susan Bowers, Christina Hoffman and Jeff Serrero.** (Berry College) Striped bass (*Morone saxatilis*) spawning activity and egg drift in the Upper Mobile River Basin.
- 2:00 97 **Adams, S. Reid and Jan Jeffrey Hoover.** (U.S. Army Engineer Waterways Experiment Station) Habitat affinities of a highly endemic desert pupfish.
- 2:15 98 **Timmons, Tom J. and Tyrone A. Highbanks.** (Murray State University) Exploitation and mortality of paddlefish, *Polyodon spathula*, in the lower Tennessee and Cumberland Rivers.
- 2:30 99 **Schultz, David L., Jason Houston and Taeger Gisclair.** (Nicholls State University) Egg size variation among populations of the Gulf pipefish, *Syngnathus scovelli*.
- 2:45 100 **Schorr, Mark and Michael Meador.** (University of Tennessee at Chattanooga and U.S. Geological Survey) Physicochemical characteristics of striped bass, *Morone saxatilis*, habitat during summer stratification in a large southern reservoir.
- 3:00 101 **Killgore, K. Jack , Jan Jeffrey Hoover and James P. Kirk.** (U.S. Army Engineer Waterways Experiment Station) Fish assemblages in borrow pits along the lower Mississippi River.
- 3:15 102 **Kirk, James, P., James V. Morrow, Jr., K. Jack Killgore and Howard E. Rogillio.** (U.S. Army Engineer Waterways Experiment Station and Louisiana Department of Wildlife and Fisheries) Recommendations to enhance the gulf sturgeon recovery/management plan.

EVOLUTION - Nurs 242

Presiding: *Walter J. Diehl*, Mississippi State University

- 3:00 103 **Bielawski, Joseph P. and John R. Gold.** (Texas A&M University) A maximum likelihood approach to inferring phylogenetic relationships of the genus *Pimephales*.
- 3:15 104 **Stringer, Gary L.** (Northeast Louisiana University) Evolutionary development of Cretaceous teleosts: new evidence from otoliths.
- 3:30 105 **Clark, Catherine M., Thomas R. Wentworth and David M. O'Malley.** (North Carolina State University) Phylogeographic variation in eastern North American *Abies*.
- 3:45 106 **Herr, J. M., Jr.** (University of South Carolina) On the origin of leaves: the telome theory revised.
- 4:00 107 **Moore, Debra S., Ken R. Marion and Scott F. Michael.** (University of Montevallo and University of Alabama at Birmingham) Relationships among the southeastern *Hyla* as revealed by mitochondrial cytochrome *b* sequence analyses.
- 4:15 108 **House, Russell F. and Jeri W. Higginbotham.** (Jacksonville State University) A Quaternary pollen sequence from northeast Alabama.
- 4:30 109 **Radenbaugh, Todd A.** (University of Regina) Spatio-temporal ecological scales on the Canadian Prairie Ecoregion.
- 4:45 110 **McElroy, Tom C. and Walter J. Diehl.** (Mississippi State University) Heterosis in the earthworm *Eisneia fetida andrei*: interactive effects of ontogeny and environment.

Friday Morning, April 17, 1998**FISH ECOLOGY - Nurs 242**

Presiding: *Neil Douglas*, Northeast Louisiana University

- 9:00 111 **O'Connell, Martin T.** (University of Southern Mississippi) Does the temporary habitat of an inundated floodplain offer increased food resources to fishes in a low order, blackwater stream?

- 9:15 112 **Heins, David C., Scarlet S. Singer and John A. Baker.** (Tulane University and Clark University) The co-occurrence of reproduction in female threespine stickleback, *Gasterosteus aculeatus*, and parasitic infection by the cestode *Schistocephalus solidus*.
- 9:30 113 **Cashner, Robert C., Michael A. Poirrier, Chris Schieble, Jeff Stewart and Julian M. Humphries.** (University of New Orleans) Temporal and spatial patterns of fish distribution in the Lake Pontchartrain estuary.
- 9:45 114 **Paxton, Christopher J.** (University of Tennessee, Knoxville) Life history of the redband darter, *Etheostoma luteovinctum*.

SYMPOSIUM - Nurs 338

Bottomland Hardwood Restoration

Sponsored by the Ecological Society of America, Southeastern Chapter

Presiding: Bob Keeland, USGS National Wetlands Research Center and Kay Kirkman, Joseph Jones Ecological Research Center

- 8:00 **Keeland, Bob and Kay Kirkman.** (USGS National Wetlands Center and Joseph Jones Ecological Research Center) Welcome.
- 8:05 115 **Keeland, Bobby D., James A. Allen, Harvey Kennedy and Andy Clewell.** (USGS National Wetlands Research Center, USDA Forest Service- Pacific Southwest Research Station, USDA Forest Service- Southern Hardwoods Laboratory and A.F. Clewell, Inc.) Introduction to "A Guide to Bottomland Hardwood Restoration."
- 8:15 116 **Ouchley, Keith and Wylie C. Barrow, Jr.** (Louisiana State University and USGS National Wetlands Research Center) Characteristics of old-growth bottomland hardwood forests of the lower Mississippi River alluvial valley in Louisiana.
- 8:45 117 **DeLoach, Judy O. and Timothy L. Davis.** (US Army Corps of Engineers, Memphis District) The U.S. Army Corps of Engineers' role in regulating bottomland hardwood wetlands.
- 9:00 118 **Haynes, Ronnie.** (US Fish and Wildlife Service) Bottomland forest re-establishment in the lower Mississippi River Valley.
- 9:30 119 **Brown, Cynthia R. and Mark Swan.** (The Nature Conservancy) Conservation planning and implementation in the Mississippi Alluvial Valley.

10:00 **BREAK**

- 10:15 120 **Williams, Hans M.** (Stephen F. Austin State University) Restoration techniques in bottomland hardwood forests.
- 10:45 121 **McCoy, John W., Bobby D. Keeland and James A. Allen.** (USGS National Wetlands Research Center and USDA Forest Service- Pacific Southwest Research Station) Natural establishment of woody species on previously farmed bottomland hardwood sites.
- 11:15 122 **Hoover, Jan Jeffrey and K. Jack Killgore.** (US Army Engineer Waterways Experiment Station) Fishes of bottomland hardwood wetlands.

INVERTEBRATE ZOOLOGY - Nurs 322

Presiding: *Frank Jordan*, Loyola University New Orleans

- 8:00 123 **Fant, Michael and Jeff Jack.** (Western Kentucky University) Survey of invertebrate communities in a temporary karst wetland.
- 8:15 124 **George, Steven G., Charles Allen and Malcolm F. Vidrine.** (Dyntel CZP, Northeast Louisiana University and Louisiana State University at Eunice) A survey of the freshwater mussels (Mollusca: Unionidae) from Brushy and Walnut Bayous in northeast Louisiana.
- 8:30 125 **Barreras, Blanca E. and Frank A. Romano.** (Jacksonville State University) A preliminary analysis of a distributional survey of riparian zone Tardigrada of Choccolocco Creek, Alabama.
- 8:45 126 **Nichols, Phillip B. and Frank A. Romano.** (Jacksonville State University) A preliminary survey on the distributional and altitudinal population patterns of Tardigrada on Dugger Mountain, Alabama.
- 9:00 127 **Romano, Frank A., George R. Cline and Paul Rogers.** (Jacksonville State University) A preliminary analysis of a distributional survey of terrestrial Tardigrada from Hawk Mountain Sanctuary, Hawk Mountain, PA.
- 9:15 128 **Townsend, Victor R. Jr. and Bruce E. Felgenhauer.** (University of Southwestern Louisiana) Cuticular scales of spiders.
- 9:30 129 **Treadaway, Rex A. and Stephen C. Landers.** (Troy State University) Feeding experiments with the ciliated protozoan *Hyalophysa chattoni*, an ectocommensal of the grass shrimp *Palaemonetes*.
- 9:45 130 **Burden, B., K. Tindall and L. Hargis.** (Louisiana State University-Shreveport) Effects of salt-tolerant cotton on the development of tobacco budworm larvae.

PLANT SYSTEMATICS I - Nurs 340

Presiding: *J.M. Herr, Jr.*, University of South Carolina

- 9:15 131 **Watson, Linda E. and Timothy M. Evans.** (Miami University and Hope College) Phylogeny of Tribe Anthemideae (Asteraceae), an analysis of nuclear and plastid sequences.
- 9:30 132 **Allison, James R. and Loran C. Anderson.** (Georgia Department of Natural Resources and Florida State University) *Sideroxylon duncanorum* (Sapotaceae), a new buckthorn from *Pinus palustris*-dominated communities of southeastern Georgia.
- 9:45 133 **Drozda, Nicholas and Zack E. Murrell.** (Western Kentucky University) Variation and species boundaries in *Hexastylis heterophylla* (Ashe) Small.
- 10:00 134 **Anders, Constance M. and Zack E. Murrell.** (Western Kentucky University) Genotypic and phenotypic variation in *Spiraea virginiana* Britton.
- 10:15 135 **Cox, Patricia B.** (University of Tennessee, Knoxville) An overview of the subtribe Liatrinae (Eupatorieae: Compositae).
- 10:30 136 **Pittman, Albert B. and Ann Darr.** (South Carolina Heritage Trust Program) Two interesting Compositae collections from the sandhills of South Carolina.
- 10:45 137 **Unwin, Matthew M. and Linda E. Watson.** (Miami University) Systematics of *Lachnocaulon* (Eriocaulaceae).
- 11:00 138 **Moynihan, Jeremy and Linda E. Watson.** (Miami University) A phylogenetic study of *Neolaugeria* (Rubiaceae) using ITS sequence data.
- 11:15 139 **Myers, Scott A. and Zack E. Murrell.** (Western Kentucky University) Evidence from nuclear rDNA for the phylogenetic placement of African dogwoods (*Cornus* subg. *Afrocrania*).

PLANT SYSTEMATICS II- Nurs 321

Presiding: *Richard Stalter*, St. John's University

- 9:15 140 **McMillan, Patrick D. and Richard D. Porcher.** (The Citadel) *Arnoglossum* sp. 1 = *Mesadenia elliotii* Harper in South Carolina and the Southeast.

- 9:30 141 **Thomas, R. Dale, Eric Sundell, Carl Amason and Chris Doffitt.** (Northeast Louisiana University and University of Arkansas, Monticello) A checklist of the vascular plants of Ashley, Bradley, Calhoun, Drew and Union counties of southern Arkansas.
- 9:45 142 **Allen, Charles and Malcolm Vidrine.** (Northeast Louisiana University and Louisiana State University at Eunice) Flora of Cajun Prairie in southwestern Louisiana.
- 10:00 143 **Haynes, Robert R. and Steven L. Ginzburg.** (University of Alabama) Optimizing label data entry for herbarium data bases.

HERPETOLOGY - Nursing Auditorium

Presiding: *Laurence M. Hardy*, Louisiana State University in Shreveport

- 8:00 144 **Rogers, Charles P. and George R. Cline.** (Jacksonville State University) Anuran breeding phenology at a northeast Alabama pond.
- 8:15 145 **Oliver, Autumn and George Cline.** (Jacksonville State University) Preliminary morphometric analysis of shape in Alabama turtles.
- 8:30 146 **Lapp, Kevin and R. Wayne Van Devender.** (Appalachian State University) Natural history and population characteristics of the salamander *Plethodon wehrlei* on Saddle Mountain in Surry County, North Carolina.
- 8:45 147 **Lang, Cynthia and Robert G. Jaeger.** (University of Southwestern Louisiana) Co-defense of territories by male-female pairs in the red-backed salamander (*Plethodon cinereus*).
- 9:00 148 **Moser, John G. Jr., James D. Couch and George R. Cline.** (Jacksonville State University) Breeding phenology of two ponds in northeast Alabama.
- 9:15 149 **Adams, Jason R. and George R. Cline.** (Jacksonville State University) Population trend analysis using calling indices in northeastern Alabama wetlands.
- 9:30 150 **Andrews, Kenneth D. and John L. Carr.** (Glendale Community College and Northeast Louisiana University) Variation in the scleral ossicles of cryptodiran turtles.
- 9:45 151 **Akin, Jonathan A. and Greg S. Sonnier.** (University of Southwestern Louisiana) Mother-offspring interactions in the ground skink, *Scincella lateralis*.

- 10:00 152 **Julian, James and James Howard.** (Frostburg State University) Translocation of amphibians into mitigated and existing wetlands - a review of a new protocol.

ANIMAL PHYSIOLOGY - Nurs 322

Presiding: *Jay A. Yoder*, The Illinois College

- 10:15 153 **Stevens, Benjamin W., Aaron D. Atwood and Jay A. Yoder.** (The Illinois College) Squalene: a naturally-occurring skin lipid that serves as an attractant to ticks.
- 10:30 154 **Rivera, Richard, Mathius J. Sedivec, William E. Dobson and Mark E. Venable.** (Appalachian State University) The effects of 1,1,3-tricyano-2-amino-1-propene (Triap) on arm regeneration in *Microphiopholis gracillima*.
- 10:45 155 **Cash, W.B. and R.L. Holberton.** (University of Mississippi) Corticosterone and behavior in the freshwater turtle, *Trachemys scripta elegans*.
- 11:00 156 **Hooker, Ben and Mathius J. Sedivec.** (Appalachian State University) Effects of 1,1,3-tricyano-2-amino-1-propene (Triap) on the regeneration of crushed sciatic nerve in adult rats.

ICHTHYOLOGY - Nursing Auditorium

Presiding: *Mark Schorr*, University of Tennessee at Chattanooga

- 10:30 157 **Skelton, C.E. and D.A. Etnier.** (University of Tennessee, Knoxville) *Etheostoma denoncourti* revisited.
- 10:45 158 **Kinziger, Andrew P., David A. Neely and Richard L. Raesly.** (Frostburg State University and University of Alabama, Tuscaloosa) A new species of sculpin (Cottidae: *Cottus*) from the mid-Atlantic region of the eastern United States.
- 11:00 159 **Cage, Bryan and Frank Pezold.** (Northeast Louisiana University) A review of the spinycheek sleepers (Teleostei: *Eleotris*) from the eastern Pacific Basin.
- 11:15 160 **Layman, Steven R.** (CH2M HILL) Species diversity and phylogenetic relationships of the subgenus *Doration* (Percidae: *Etheostoma*).

Friday Afternoon, April 17, 1998**ICHTHYOLOGY - Nursing Auditorium**

Presiding: *Robert C. Cashner*, University of New Orleans.

- 1:30 161 **Neely, David A., Phillip M. Harris and Richard L. Mayden.** (University of Alabama) Morphological differentiation in populations of the frecklebelly madtom, *Noturus munitus*.
- 1:45 162 **Piller, Kyle R. and Henry L. Bart, Jr.** (Tulane University Museum of Natural History) Morphological variation of the redbfin darter, *Etheostoma whipplei*, with comments on the status of the subspecific populations.
- 2:00 163 **Richardson, Linda R. and John R. Gold.** (Texas A&M University) Evolution of the *Cyprinella lutrensis* species-group. IV - Geographic variation in the mitochondrial DNA of the red shiner (*Cyprinella lutrensis*): evidence for pre-Pleistocene connection of western Gulf Coastal Plain drainages.
- 2:15 164 **Durrant, Gary Edward.** (Jacksonville State University) A new hypothesis for swimming locomotion in tunas and cetaceans: does the caudal fin function as a centrifugal pump?
- 2:30 165 **Kuhajda, Bernard R., David A. Neely and Richard L. Mayden.** (University of Alabama) Do Ohio lampreys (*Ichthyomyzon bdellium*) inhabit Alabama waters?
- 2:45 166 **Baxter, John T.** (University of Tennessee, Knoxville) The fish fauna of the Upper Cumberland River drainage in Tennessee.

SYMPOSIUM - Nurs 338**Bottomland Hardwood Restoration**

Sponsored by the Ecological Society of America, Southeastern Chapter

Presiding: **Bob Keeland**, USGS National Wetlands Research Center and
Kay Kirkman, Joseph Jones Ecological Research Center

- 2:00 167 **Ouchley, Kelby.** (US Fish and Wildlife Service) Bottomland hardwood restoration in the lower Mississippi River Valley - a practitioner's perspective.
- 2:30 168 **Ribbeck, Kenny and Larry Savage.** (Louisiana Department of Wildlife and Fisheries) Restoration of bottomland hardwoods: a 30 year perspective.

- 3:00 169 **Dewey, Janet C., Stephen H. Schoenholtz, John A. Stanturf, David E. Pettry and Edward W. Mauritz.** (Mississippi State University and USDA Forest Service) Along the path to recovery: soil as an indicator of bottomland hardwood forest restoration.
- 3:30 170 **Schweitzer, Callie Jo.** (USDA Forest Service- Center for Bottomland Hardwood Research) Measuring success in bottomland hardwood forest restoration.
- 4:00 171 **Staten, Mike.** (Anderson-Tully Company) Integrating bird habitat in industrial forest management.
- 4:30 Closing Comments and Open Discussion.

PLANT ECOLOGY - Nurs 340

Presiding: *Loretta Battaglia*, University of Georgia, Savannah River Ecology Laboratory

- 2:00 172 **Franklin, Scott B., Philip A. Robertson, Brian P. Klubek, James S. Fralish and Felix Ponder.** (University of Memphis, Southern Illinois University and North Central Forest Experiment Station) Physiological diversity of soil microorganisms in burned and unburned upland hardwood stands.
- 2:15 173 **Beasley, Rodney, Paul Davison, Francis Menapace and Dan Wujek.** (University of North Alabama and Central Michigan University) *Caloglossa leprieurii*, an estuarine red alga in the Tennessee River and its growth in culture.
- 2:30 174 **Choberka, Erica and D.K. Smith.** (University of Tennessee, Knoxville) Bryophyte recruitment and succession on fir logs in the Great Smoky Mountain National Park.
- 2:45 175 **Burkhead, Juliette C., Jillian A. Marshall and Lawrence W. Zettler.** (The Illinois College) *In vitro* symbiotic seed germination of the Florida Butterfly Orchid, *Encyclia tampensis*: evidence of non-specificity for mycorrhizal fungi by an epiphytic orchid.
- 3:00 176 **Johnson, Margaret and Philip A. Robertson.** (Southern Illinois University) The effect of canopy closure on growth and reproduction in *Matelea obliqua*.
- 3:15 **BREAK**

- 3:30 177 **Munkacsi, Andrew, James Veselenak, Anne Larson and Lawrence W. Zettler.** (University of Illinois-Springfield and The Illinois College) A preliminary survey of the endomycorrhizal fungi of *Spiranthes magnicamporum* (Orchidaceae) from a native Illinois prairie.
- 3:45 178 **Taylor, David D.** (USDA Forest Service) Kentucky populations of the orchid *Platanthera integrilabia* - three years of observations.
- 4:00 179 **Sunley, Jennifer A., Tonya Wilson Delaney and Lawrence W. Zettler.** (The Illinois College) Seed propagation of the epiphytic Green-fly Orchid, *Epidendrum conopseum*, using its endophytic fungus: confirmation of mycorrhizal symbiosis.
- 4:15 180 **Emrick, Verl and Alison Hill.** (US Army Construction and Research Labs) Density and frequency of *Rhus michauxii*, a federally endangered species, in relation to community association at Fort Pickett Military Reservation, Virginia.
- 4:30 181 **Adair, Matthew S., P. Brent Nichols and Safaa Al-Hamdani.** (Jacksonville State University) Effect of chromium (VI) on *Salvinia* growth and carbohydrate accumulation.
- 4:45 182 **Porcher, Richard D., Patrick D. McMillan and John F. Townsend.** (The Citadel) The rediscovery of *Forestiera godfreyi* (Oleaceae) in South Carolina.
- 5:00 183 **Sobieraj, James H. and Howard S. Neufeld.** (Appalachian State University) Differential susceptibility to cavitation in petioles of one and two year old leaves of *Galax aphylla*.

ASB TEACHING SEMINAR - Nurs 322

Sponsored by the ASB Education Committee

2:00 **Brian Shmaefsky.** (Kingwood College) Biotechnology Education: Laboratory Applications.

TEACHING BIOLOGY - Nurs 322

Presiding: Fred Groves, Northeast Louisiana University

- 2:45 184 **Collins, Linda T. and Bell, Rebekah P.** (University of Tennessee at Chattanooga) How to teach chi-square analysis in an introductory genetics laboratory.

- 3:00 185 **Durrant, Gary, George Cline, Tom Baucom, Kelly Gregg and Frank Romano.** (Jacksonville State University) Aerospace education across the curriculum: training high school science teachers in satellite remote sensing and global positioning systems.
- 3:15 186 **Kopp, Rick.** (Georgetown College) Lessons from PAEMS: a summer science camp for highly-motivated high school students.
- 3:30 187 **Sauterer, Roger and Jody Jones.** (Jacksonville State University) A rapid, simple and inexpensive laboratory experiment in gel filtration chromatography for undergraduate instructional laboratories.

HERPETOLOGY - Nursing Auditorium

Presiding: *Ronn Altig*, Mississippi State University

- 3:15 188 **Adams, Jason R. and George R. Cline.** (Jacksonville State University) Survey results from the Fort McClellan Herpetofaunal Inventory and Monitoring Project (Aug 1996 - Mar 1998).
- 3:30 189 **Himes, John.** (Louisiana State University in Shreveport) Autecology of the Louisiana pine snake (*Pituophis melanoleucas ruthveni*) in north-central Louisiana.
- 3:45 190 **Gillette, Jennifer R., Robert G. Jaeger and Megan E. Gibbons.** (University of Southwestern Louisiana) Intersexual association preferences in the red-backed salamander, *Plethodon cinereus*: fickle or faithful?
- 4:00 191 **Bridges, Andrew and Michael E. Dorcas.** (Texas A&M University and University of Georgia, Savannah River Ecology Laboratory) Temporal variation in anuran calling behavior: implications for calling surveys and population assessment.
- 4:15 192 **Gibbons, Megan E., Jennifer R. Gillette and Robert G. Jaeger.** (University of Southwestern Louisiana) Alternative life styles in a terrestrial salamander: are females found in same-sex pairs attracted to each other?
- 4:30 193 **Morgan, Christina D. and Rebecca A. Pyles.** (East Tennessee State University) Niche partitioning in a community of salamanders.

BETA BETA BETA BIOLOGICAL SOCIETY

The following papers are not listed in the order in which they will be presented. The schedule for these presentations will appear in the Beta Beta Beta program available at the meeting.

Additional titles may have been submitted to the final program.

SOUTHEASTERN REGION DISTRICT I

Ellis, Jana. (Sigma Gamma, Erskine College) Mercury concentration in aquatic and terrestrial snakes on the Savannah River site.

Williams, Verietta, Paulo Louzada, Jr. and Sergio Ferreira. (Tau Phi, North Carolina Agricultural and Technical State University) Effects of trehalose on yeast glutathione reductase.

Alexander, Sabina, Robert Berkowitz and Mike McCune. (Tau Phi, North Carolina Agricultural and Technical State University and Gladstone Institute of Virology and Immunology, University of California at San Francisco) HIV-1 envelope hypervariable regions, V1, V2, and V3, influence tropism and pathogenesis, *in vivo*.

Miller, Justin. (Tau Eta, Catawba College) The kinetics of pseudohyphal yeast growth.

Curtiss, Tracy. (Tau Eta, Catawba College) Cell division pattern of pseudohyphae in ascomycete yeasts.

Hand, Valerie. (Beta Rho, Wake Forest University) The effect of immunoablation on interleukin-4 and interferon-gamma *in vivo* in experimental cysticercosis.

Swan, Justin, M. Tytell and Carole Browne. (Beta Rho, Wake Forest University) Role of exogenous heat shock protein on sea urchin development.

McElveen, Melinda. (Beta Rho, Wake Forest University) Visitation of arctiid moths to a pyrrolizidine alkaloid-containing plant (*Eupatorium capillifolium*).

Poster Presentations

Williams, Tiffany, Scott Laster and Leslie Wolf. (Tau Phi, North Carolina Agricultural and Technical State University and North Carolina State University) Cystolic phospholipase A₂ cleaves arachidonic acid as part of the "common" apoptotic pathway.

Vogl, Catherine. (Tau Eta, Catawba College) Age-related changes in skeletal muscle L-type Ca²⁺ channel and ryanodine receptor gene expression.

Gray, Kathleen. (Psi, Winthrop University) Electron-microscopic studies of the muscles of tongue protraction and retraction in *Rana pipiens*.

McFadden, Andy. (Psi, Winthrop University) The distribution of microorganisms in the Kombucha mushroom through fluorescence microscopy.

SOUTHEASTERN REGION DISTRICT II

Nickles, Jennifer and Mary Jacobs. (Mu Phi, Jacksonville State University) Preliminary studies on the purification of potato tyrosinase (polyphenol oxidase).

Smith, Gregory and Terry Richardson. (Beta Zeta, University of North Alabama) Population dynamics of *Viviparus subpurpureus* in a temporary riparian wetland.

Ball, Elizabeth. (Pi Delta, East Tennessee State University) Isolation and characterization of an Arabidopsis cDNA to an ANP-like peptide.

Dulaney, Douglas. (Pi Delta, East Tennessee State University) Structural arrangement of the gene for an ANP-like peptide in plants.

Nicholson, Catherine. (Pi Delta, East Tennessee State University) Where have all the frogs gone? Developmental effects of acidic conditions on two species.

Springate, Amy. (Pi Delta, East Tennessee State University) The effects of pH on embryo size in two frog species: *Xenopus laevis* and *Rana sylvatica*.

Mahar, Susan. (Pi Delta, East Tennessee State University) The effects of various agents and drugs on the synthesis of phosphorylated Tau.

Smith, Alex. K. (Kappa Pi, Millsaps College and University of Mississippi Medical Center) PDGF stimulates changes in the phosphorylation of muscle cell proteins.

Hamm, Jennifer. (Kappa Pi, Millsaps College) The influence of different lengthening regimes on the length-tension curve of the circular layer of uterine circular muscle in the garter snake.

Reynolds, Jeremy. (Kappa Pi, Millsaps College) The influence of different lengthening regimes on the length-tension curve of the circular layer of uterine longitudinal muscle in the garter snake.

Bosarge, Jerusha. (Kappa Pi, Millsaps College) The influence of different lengthening regimes on the length-tension curve of the heart of the toad.

Marksberry, Elizabeth. (Mu Iota, Northern Kentucky University) Impact of aircraft de-icers at the GCIA airport on Gunpowder Creek and the possible biodegradation of the de-icer by *Sphaerotilus natans*.

Kenny, Ryan. (Mu Iota, Northern Kentucky University) Determining the metastatic potential of cancer cells by the presence of stromelysin and timp expression.

Abdennabi, Saed. (Mu Iota, Northern Kentucky University) Dehydroepiandrosterone (DHEA): Effect on fertility and fetal development in rats.

In the January issue of the *ASB Bulletin* there were three errors in the registration form due to a mistake by the editor. On the following two pages a corrected form appears. The corrections are in **13 point bold italics** for your convenience. *Please use this form instead of the one printed in the January issue*, or find it on the web page <http://www.nlu.edu/asb>.

**59th Annual Meeting Hosted by Northeast Louisiana University
Monroe, Louisiana April 15-18, 1998**

PRE-REGISTRATION FORM

(Type or clearly print one form per registrant)

Name _____

☐ Faculty ☐ Graduate Student ☐ Undergraduate Student

Institution _____

Mailing Address _____

City _____ State _____ Zip _____

Office Phone ()

Email _____

Affiliation (check
where appropriate):

☐ ASB	☐ ASIH	☐ BBB	☐ BSA
☐ ESA	☐ SFC	☐ SABS	☐ SWS

Pre-Registration fee:

Regular: \$50.00 _____ \$ _____

Student: \$20.00 _____ \$ _____

Late registration: Regular \$65.00; Student \$25.00

Wednesday Evening ASB Social:

I plan to attend: yes ☐ no ☐

Thursday Evening *Fais Do-Do/ Crawfish/Cochon de Lait Fête:*

Regular: \$25.00 x tickets _____ \$ _____

Student: \$20.00 x tickets _____ \$ _____

Friday Evening ASB Banquet:

Regular: \$25.00 x tickets _____ \$ _____

Student: \$20.00 x tickets _____ \$ _____

Entree preference (check one): ☐ **beef** ☐ poultry ☐ vegetarian

Breakfasts:

ASB Past Presidents \$7.00 x tickets _____ \$ _____

SABS/BSA \$12.00 x tickets _____ \$ _____

Luncheons:

Beta Beta Beta \$10.00 x tickets _____ \$ _____

ESA/SE Chapter \$10.00 x tickets _____ \$ _____

SWS \$10.00 x tickets _____ \$ _____

Field Trips:

1. Copenhagen \$15.00 x _____ tickets _____ \$ _____

2. Black Bayou \$10.00 x _____ tickets _____ \$ _____

3. Spring Birding \$10.00 x _____ tickets _____ \$ _____

4. Middle Branch Bog \$18.00 x _____ tickets _____ \$ _____

5. Vicksburg \$20.00 x _____ tickets _____ \$ _____

6. D'Arbonne NWR _____ \$15.00 x _____ tickets \$ _____

Total Amount Enclosed _____ \$ _____

Museum and Herbarium Reservations:

If you would like to have access to museum collections, please contact Dr. Neil Douglas at (318)-342-1799 or at "bidouglas@alpha.nlu.edu." Every attempt will be made to accommodate your needs, but scheduling may be "first come, first serve" for research space. Lab equipment beyond a microscope (forceps, etc.) cannot be furnished. If you wish to use herbarium collections, please contact Dr. R. Dale Thomas at (318) 342-1812.

Make checks payable to: *ASB Local Committee*

Pre-registration deadline March 19, 1998

Mail pre-registration form and check to:

Dr. Kim Marie Tolson

Biology Department

Northeast Louisiana State University

Monroe, LA 71209

AUTHOR INDEX FOR PAPERS AND POSTERS WITH ABSTRACT NUMBERS

Only first authors are indexed.

- | | | |
|-----------------------------|------------------------------|-------------------------------|
| Adair, Matthew S. - 181 | Davin, William - 96 | Jones, Ronald L. - 77 |
| Adams, Eric D. - 65 | DeLoach, Judy O. - 117 | Julian, James - 152 |
| Adams, Jason R. - 149, 188 | Devinney, Patricia - 5 | Kalinsky, Robert G. - 36 |
| Adams, S. Reid - 97 | Dewey, Janet C. - 169 | Keeland, Bobby D. - 115 |
| Akin, Jonathan A. - 151 | Dhawan, Vijender - 10 | Kelley, Randall - 37 |
| Allen, Bruce P. - 28 | Doucet, John P. - 11 | Kelly, K.A. - 21 |
| Allen, Charles - 31, 142 | Dover, Shannon L. - 15 | Killgore, K. Jack - 101 |
| Allison, James R. - 132 | Drozda, Nicholas - 133 | Kinziger, Andrew P. - 158 |
| Anders, Constance M. - 134 | Durrant, Gary - 164, 185 | Kirk, James P. - 102 |
| Anderson, Allison A. - 43 | Edwards, Adrienne - 91 | Kohnke, Laura L. - 85 |
| Andrews, Kenneth D. - 150 | Emrick, Verl - 180 | Kopp, Rick - 186 |
| Backer, Jennifer - 44 | Ensign, William E. - 45 | Kuhajda, Bernard R. - 165 |
| Bailey, Pamela - 30 | Fant, Micheal - 123 | Kupfer, Holly - 41 |
| Barreras, Blanca E. - 125 | Farmer, Susan B. - 25 | Lancaster, David - 6 |
| Basinger, Mark A. - 63, 69 | Flagg, Raymond O. - 72 | Lang, Cynthia - 147 |
| Battaglia, Loretta - 26 | Fleming, Chris A. - 32 | Langley, Susan K. - 22 |
| Baxter, John T., Jr. - 166 | Fletcher, Tara S. - 56 | Lapp, Kevin - 146 |
| Beasley, Rodney - 173 | Flickinger, Shane T. - 12 | Layman, Steven R. - 160 |
| Beddingfield, Steven D. - 1 | Franklin, Scott B. - 172 | Leong, Laurel L. Y. - 13 |
| Bergin, Jaron J. - 52 | Freeman, Paul - 80 | Lewis, Bradley R. - 42 |
| Betts, Tashaun C. - 9 | Gatewood, Melissa - 2 | Lindsey, Kristen L. - 79 |
| Bielawski, Joseph P. - 103 | George, Steven G. - 124 | Lockhart, Brian R. - 7 |
| Booth, Robert K. - 18, 62 | Gibbons, Megan E. - 192 | Long, Jeannie - 84 |
| Bradley, Ted - 75 | Gillette, Jennifer R. - 190 | Martz, Tara E. - 34 |
| Bridges, Andrew - 191 | Grayson, Jackie C. - 17 | Matthews, Christopher R. - 83 |
| Brown, Bryan L. - 88 | Harper, Erika - 4 | McCoy, John W. - 121 |
| Brown, Cynthia R. - 119 | Haynes, Robert R. - 143 | McElroy, Tom C. - 110 |
| Burden, B. - 130 | Haynes, Ronnie - 118 | McLeod, Kenneth W. - 60 |
| Burkhead, Juliette C. - 175 | Heins, David C. - 112 | McMillan, Patrick D. - 140 |
| Cage, Bryan - 159 | Heist, Edward J. - 93 | Moore, Debra S. - 107 |
| Cash, W.B. - 155 | Herr, J.M., Jr. - 106 | Morgan, Christina D. - 193 |
| Cashner, Robert C. - 113 | Himes, John - 189 | Moser, John G., Jr. - 148 |
| Choberka, Erica - 174 | Hinkle, C. Ross - 20 | Moynihan, Jeremy - 138 |
| Clark, Catherine M. - 105 | Hitchcock, Stephanie L. - 57 | Munkacs, Andrew - 177 |
| Clyde, Gerard A., Jr. - 35 | Hooker, Ben - 156 | Myers, Scott A. - 139 |
| Coggin, Steven J. - 39 | Hoover, Jan Jeffrey - 122 | Neely, David A. - 161 |
| Collins, B. - 68 | Horn, Charles N. - 58 | Nichols, Phillip B. - 126 |
| Collins, Linda T. - 184 | House, Russell F. - 108 | Oliver, Autumn - 145 |
| Conner, William H. - 19 | Hulsey, Bannie C. - 49 | Ouchley, Keith - 116 |
| Corley, J. Brian - 48 | Hupp, Cliff R. - 82 | Ouchley, Kelby - 167 |
| Cox, Patricia B. - 135 | Hyatt, Philip E. - 73 | O'Connell, Martin T. - 111 |
| Crews, Evan - 81 | Jin, Eun-Jung - 38 | Paxton, Christopher J. - 114 |
| Cushman, Laary J. - 27 | Johnson, Margaret - 176 | |

- Peters, Jeffrey L. - 3
 Phelps, Timothy R. - 64
 Piller, Kyle R. - 162
 Pittman, Albert B. - 136
 Porcher, Richard D. - 182
 Radenbaugh, Todd A. - 109
 Ramsey, Gwynn W. - 71
 Ribbeck, Kenny - 168
 Richardson, Linda R. - 163
 Risk, Allen C. - 70
 Ritchie, Jerry C. - 23
 Rivera, Richard - 154
 Robertson, Mike S. - 8
 Robertson, Philip A. - 55
 Rogers, Charles P. - 144
 Romano, Frank A. - 127
 Sauterer, Roger - 187
 Schorr, Mark - 100
 Schultz, David L. - 99
 Schweitzer, Callie Jo - 170
 Shumway, Durland L. - 66
- Skelton, C.E. - 157
 Smee, Delbert L. - 46
 Smith, Gregory A. - 87
 Smith, Peter - 54
 Sobieraj, James H. - 183
 Soulen, Heather L. - 89
 Spratt, Henry G., Jr. - 51, 53
 Stalter, Richard - 74
 Stanton, Kathleen - 16
 Staten, Mike - 171
 Stevens, Benjamin W. - 153
 Stringer, Gary L. - 104
 Sunley, Jennifer A. - 179
 Tate, Natale - 90
 Taylor, David D. - 178
 Tennant-Clegg, Esther P. - 50
 Thomas, R. Dale - 76, 141
 Thompson, Andrew R. - 95
 Thompson, Ralph L. - 33
 Timmons, Tom J. - 98
- Townsend, Victor R. - 128
 Treadaway, Rex A. - 129
 Trisel, Donald E. - 24
 Tuberville, Tracey D. - 61
 Turner, Thomas F. - 94
 Ulrey, Christopher, J. - 59
 Unwin, Matthew M. - 137
 Varner, Chelsia L. - 40
 Vessels, Nicole - 86
 Wallace, Monica - 47
 Watson, Linda E. - 131
 Watts, Tiffany - 78
 Whitbeck, Julie L. - 29
 Williams, Hans M. - 120
 Winstead, Joe E. - 67
 Wise, Dwayne - 92
 Yamashita, Tsunemi - 14

ERRATUM

In the article: Development of the free neuromasts in the dwarf seahorse *Hippocampus zosterae* (Syngnathidae): An SEM study. (Kokkala, Wetzel and Bartsch. ASB Bulletin 45:1. 1-10) the caption for figure 11 (page 6) should read: "Random superficial neuromast on an adult specimen (arrow) located between two calcification spiracles (57x)." The rest of that caption belongs at the end of the next-to-last paragraph on page 8.

REVIEWS

Brown, Larry N. 1997. *A Guide to the Mammals of the Southeastern United States*. Univ. Tenn. Press, Knoxville, 236 pp. \$50.00 hardbound, \$25.00 paperback.

The 12 states that comprise the southeastern United States contain a remarkably diverse assortment of natural habitats—from alpine boreal forests to mangrove swamps and adjacent tropical marine waters—that are occupied by an equally diverse assortment of mammals. Larry Brown relies on 35 years of mammalogical experience, 25 of them in the southeastern United States, to write a book "designed to provide descriptive information on the mammal species of the southeastern United States and [to] serve as a general source of information about their life habits and natural history." This is the only guide to the mammals in the 12-state region, although no less than a dozen earlier texts have been devoted to the mammalian faunas in smaller parts of the region.

The topical organization of this book is similar to that of other region-oriented mammal texts, with eight introductory chapters followed by species accounts for 132 extant and four extirpated or extinct species of mammals, two appendices, a glossary, list of references, and index. The first five chapters (Studying Mammals, Mammal Characteristics and Adaptations, Mammal Conservation, The Southeastern Region and Mammal Affinities, and Preservation of Mammal Specimens) are generally well written and accurate. It's a stretch, however, to say that the first mammals "evolved about 260 million years ago during the late Paleozoic era" when the oldest mammalian fossils only date back to the Late Triassic (200 mya). Also, mammals arose from cynodont therapsids (Subclass Synapsida) and not thecodonts, a defunct taxonomic term once used to define stem archosaurs (Subclass Diapsida) and their descendants (pterosactyls, dinosaurs, crocodiles, and birds). Moreover, hemlock does not occur with spruce and fir on the tallest peaks in the southern Appalachian Mountains, but at mid-elevations with northern hardwoods, and there are six species (not five) of boreal shrews in those mountains. Brown correctly notes that the marine mammals of the region "show affinities to southern and tropical species" but doesn't mention the penultimately large contingent of mysticetes (all except Bryde's whale), odontocetes (harbor porpoise, Atlantic white-sided dolphin, and long-finned pilot whale), and pinnipeds (harbor and hooded seals) that migrate southward into the region from the northwestern North Atlantic during the winter months. Although he notes that State permits are needed to collect mammals, Brown forgets to mention that permission from landowners is a common courtesy that mammalogists are ill-advised to ignore.

The Checklist of Southeastern Mammals provides the scientific and common names, geographic distribution, habitat, and relative abundance for each mammal species that occurs in the region. The format used to define the range of each species is occasionally awkward (that of the Indiana bat, for example, is "N 1/3, SC 1/4"), and the ranges are sometimes incorrect (the smoky shrew is much more, not less, widespread than the snowshoe hare and porcupine). Habitat information is typically accurate, but for many species the relative abundances given by Brown are arguable, especially for mammals in states most distant to Brown's resident state of Florida. The big brown bat, red bat,

common deer mouse, and white-footed mouse are abundant in much of the southeastern United States, and the red-backed vole is certainly more widespread and more abundant than the rock vole.

A Key to Orders of Terrestrial Mammals in the Southeast and Color Illustrations provide some useful tips in identifying whole animals to order, but the text would not suffer if both chapters were deleted. A more useful key, if there is to be one, would include cranial and dental characters, continue below the level of order in the ordinal accounts, and have better flow from couplet to couplet. The 17 color photographs, with the exception of the harbor seal, are either out of focus, suffer from poor lighting, or the mammal is shown in an unnatural pose. Since two of the photos are also on the front cover (see the soiled feet of the coyote?) and all are repeated as black-and-whites in the species accounts, why not delete the expensive color plates (put the harbor seal photo on the cover) and reduce the price of the book.

Species accounts are organized by order, family, and species. Each species account has six parts--Identification, Geographical Range, Habitat, Natural History, Remarks, and Selected References. The species accounts are followed by abbreviated accounts for extirpated or extinct native species. Brown's knowledge of Florida mammals is impressive and current, and his Florida records of the little mastiff bat and Jamaican fruit bat are provocative. His comments about mammals in the northeastern part of the 12-state region, however, are naive. For example, Brown mentions the unsettled taxonomic status of the silver rice rat, which occurs only in south Florida, but he doesn't mention the enigmatic Maryland shrew or Allegheny woodrat, which don't. Some statements in the species accounts require clarification. The gray wolf (not the mountain lion) had the largest geographic distribution of any mammal in North America, sirenians also inhabit West Africa, the paraxonic foot of artiodactyls is modified such that the weight of the body passes between the third and fourth digits (not second and third), and unguligrade (not digitigrade) is the term that refers to walking on the tips of toes that are sheathed in hooves. The humpback whale strands more frequently than other mysticete species in the southeastern United States and stocks have increased (not decreased) recently such that human-whale interactions are becoming all too common. How could the short-finned pilot whale be "the mainstay of the Newfoundland whaling industry" when it only ranges "as far north as Virginia"? Why aren't the American marten and gray whale included in the list of extirpated species? Why are some shrews economically important when others are not, and aren't all mammals ecologically important?

A black-and-white photograph and range map accompany the accounts of most terrestrial species, and several line drawings of skulls are also provided. The photographs and line drawings are generally good and they show some diagnostic characters not mentioned in the text. Many range maps are inaccurate, especially in the northern part of the region, because they do not include recent records from the literature. This list includes, but is not limited to, the pygmy shrew, masked shrew, northern short-tailed shrew, southeastern bat, Indiana bat, Rafinesque's big-eared bat, Brazilian free-tailed bat, marsh rabbit, snowshoe hare, woodchuck, fox squirrel, red squirrel, beaver, hispid cotton rat, marsh rice rat, eastern harvest mouse, golden mouse, southern bog lemming, meadow jumping mouse, porcupine, American fisher, marten, eastern spotted skunk, manatee, wild

boar, and sei whale. For the northern yellow bat, the distribution shown in the range map and that described in the text do not agree.

The book closes with two appendices, a glossary, selected references, and index. Appendix I (Dental Formulas of Southeastern Terrestrial Mammals) and II (Standard Measurements and Weights of Southeastern Terrestrial Mammals) provide useful information about mammals, but it is impossible to tell the age, sex, or provenance of the measured specimens. Measurements of the relatively large *Sorex longirostris fisheri* were not included in the measurements provided for the southeastern shrew, and those that are provided, presumably of *S. l. eionis* and *S. l. longirostris*, average smaller in total length and tail length than those given for the pygmy shrew. External measurements are given in millimeters regardless of the animal's size or phylogeny, but weights are given in grams for small mammals (a shrew or bat) and in pounds for large mammals (an opossum, armadillo, rabbit, or ungulate); rodent and carnivore weight units are mixed (they must be paraphyletic). The Glossary provides definitions for 184 terms used in the text. Some definitions are inaccurate or too brief. An aardwolf is a hyaenid (not a canid), the dentary does not always contain teeth, lacrimal also refers to a pair of bones in the skull, precocial offspring require little parental care, and the tail fluke of whales and manatees is flattened dorsoventrally (not laterally). The list of Selected References is not balanced geographically and some references have more recent editions that were available in time to be included here. The Index has several misspellings (chisel-like incisors, diastoma, *Lasirurs intermedius*, *Myotis grisescens*), and it's pedantic to index separately singular and plural names of the same species (raccoon and raccoons).

Many lapses in the text can be attributed to an antiquated manuscript that's been hibernating for too long. The 583 references in the species accounts, in descending numerical order by decade, were published in the 1970s (147, 25.2%), 1980s (142, 24.4%), 1960s (90, 15.4%), 1950s (71, 12.2%), and then the 1990s (64, 11.0%). Brown follows recent scientific evidence to assign the jumping mice to the family Dipodidae and the rats, mice, and voles to the family Muridae. He acknowledges the change from Keen's bat (*Myotis keenii*) to the northern bat (*M. septentrionalis*) and the change in the Florida mouse (*Peromyscus* instead of *Podomys*), but he follows neither. However, *Microsorex* hasn't been used as a genus since the early 1980s, Rafinesque's and Townsend's big-eared bats now go by *Corynorhinus* instead of *Plecotus*, the right whale (*Balaena glacialis*) now goes by black right whale (*Eubalaena glacialis*), the long-finned pilot whale is known as *Globicephala melas* and not *G. melaena*, the short-tailed weasel is now known as the ermine, the river otter is known as *Lontra* instead of *Lutra* by many authorities, and the wapiti goes by *Cervus elaphus* instead of *C. canadensis*. Finally, Burma and the Celebes have changed their names to Myanmar and Sulawesi, respectively, in the last decade.

There is another issue about common names that deserves mention. Brown unambiguously calls *Peromyscus maniculatus* the common deer mouse instead of the deer mouse, and he calls *Physeter macrocephalus* the giant sperm whale instead of the sperm whale. These lengthier common names are preferable because they will not be confused with common names assigned to higher taxonomic categories (the genus *Peromyscus* includes the deer mice, and the family Physeteridae includes the sperm whales). Likewise, *Sorex dispar* should be called the rock shrew or big-tailed shrew to avoid confusion with shrews of the genus *Sorex*, the long-tailed shrews. In a lapse, Brown refers to the hispid

cotton rat and marsh rice rat as the cotton rat and rice rat, names used to refer to the speciose genera *Sigmodon* and *Oryzomys*, respectively. He also refers to members of the family Balaenopteridae as fin whales, a common name that applies to *Balaenoptera physalus*, rather than rorquals.

North American mammalogists typically spell pygmy (as in the pygmy shrew, pygmy sperm whale, and pygmy killer whale) with a "y" rather than an "i." Brown zealously emends (improperly) the spelling of this word every time it occurred in a bibliographic citation. Brown also emends (again improperly) bibliographic citations by altering the spelling of *Myocastor* (which is misspelled throughout the text except in Appendix I); he italicizes most genus/species names when some were not italicized in their titles; he misspells the names of 12(!) authors; and he inserts common names (two in the case of *Felis concolor*) in the citations of Mammalian Species accounts. Finally, the sole member in a monotypic order, family, or genus should not be referred to in plural (aardwolves) because it implies more than one species.

The University of Tennessee Press has produced a book with a double-column format and type font that is attractive and easy to read. Wasted space at the beginning and end of many chapters could have been filled with line drawings, as was done at the beginning of each ordinal account, or by more (not less) copy from the author. Fractions typically are spelled out (the tail of the golden mouse is "between two and three-eighth [sic] inches and three and three-quarters inches long"), but I also found fractions and decimals in the text as well. Whole numbers are both spelled out and depicted numerically; there is inconsistent use of commas before conjunctions in strings of words or phrases; Southeast is sometimes capitalized and sometimes not; the word "very" is used too often; the upper arm of a bat is the humerus (not humerous); organisms that occupy the same habitat in space and time are syntopic (not syntropic); and two sets of words -- "estrus" and "estrous," and "that" and "which"--are used interchangeably. Brown uses some words that sound awkward, such as "writing on each species" and "the mother remates for the next year's litter"). We are told twice that jumping mice "make very interesting, unusual, and attractive pets." Also, identical citations are cited differently at different places in the text. The press and author should have worked together better to solve some of these shortcomings.

This text will be a welcome addition to the personal library of any bibliophile who feels compelled to own every text on mammals. At today's prices, the book's modest price shouldn't inhibit its purchase by professional mammalogists and wildlife lovers in this densely populated geopolitical region. Nonetheless, I think my money would be better spent on Brown's upcoming opus on Florida mammals or any one of the other guides to mammals in this delightfully diverse part of our country.

WM. DAVID WEBSTER, *Department of Biological Sciences, University of North Carolina at Wilmington, Wilmington, NC 28403-3297.*

NEWS OF BIOLOGY IN THE SOUTHEAST

Jon R. Fortman-News Editor
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ABOUT PEOPLE AND PLACES

MISSISSIPPI

Mississippi State University, Department of Biological Sciences. Dr. Lewis R. Brown was recently presented a plaque by the MSU Science and Technology Research Center situated at the Stennis Space Flight Center, in Bay St. Louis, MS. The plaque read, "In appreciation of His Vision, Leadership and Dedication for the Establishment of the MSU Research Center at the Mississippi Test Facility 1969-1974."

NORTH CAROLINA

East Carolina University, Department of Biology. Drs. Roger Rulifson (Biology and ICMR) and David Griffith (ICMR) received a UNC Sea Grant Program \$48,552 award for "Biological and Social Characterization of the N.C. Spiny Dogfish Fishery." Recently, Dr. Roger Rulifson was awarded a \$30,000 U.S. Fish and Wildlife Service Grant for research, "Use of Flap Gates and fish Slots in the water control structures of Lake Mattamuskeet by Migrating fishes and Blue Crabs." Dr. Robert Christian received a \$10,339 Water Resources Research Institute grant for "Contribution to Long-term Modeling Tier of the Neuse River and Estuary." Dr. Joseph Luczkovich (Biology and ICMR), Dr. Hal Daniel III (Biology) and Dr. Mark Sprague (Physics) received a \$78,522 N.C. Division of Marine Fisheries grant for their research, "Characterization of Spawning Habitats of Red Drum, Spotted Seatrout, and Weakfish (Family Sciaenidae) by use of Hydroacoustic Surveys." Dr. Trip Lamb received a \$195,000 NSF Grant for research entitled, "Cladistic Biogeography of the Endemic Herpetofauna in Southern Africa: Phylogenetic Reconstruction and Area Analysis." Co-investigator is Dr. Aaron M. Bauer of Villanova University, Department of Biology.

VIRGINIA

University of Richmond, Department of Biology. A new faculty member, Dr. Peter Smallwood, Assistant Professor of Biology will be teaching courses in organismal biology, behavior, and ecology. Dr. Smallwood received his Ph.D. in Ecology and Evolutionary Biology from the University of Arizona. His research interests encompass studies of the behavior of individual organisms as well as plant-animal interactions and their community-wide effects.

MUSEUMS AND BOTANICAL GARDENS

LOUISIANA

Northeast Louisiana University Museum of Zoology. In a recent issue of *Copeia*, the collection of fishes at NLU was cited as one of the four fastest growing collections in North America. The article entitled "Second Survey of Fish Collections in the United States and Canada" listed the Los Angeles County Museum, Tulane University, National Museum of Natural History in Washington, D.C. and Northeast Louisiana University as collections that had grown the most since the initial survey in 1976. The NLU Museum of Zoology was listed as fifth largest in terms of total number of specimens, and was third among educational institutions.

In ranking North America ichthyological resource centers, weighted categories were used to establish an index number for 117 collections. Categories included the following: total number of specimens, total number of lots, holdings of type specimens, visitors, loan activity, exchanges, number of species, computerization, educational function, geographic coverage, staff size and others. With an index number of 81, the NLU Museum of Zoology fish collection was designated a Regional Center and was ranked fifteenth of all national, state, private, and university collections. Among academic institutions only the University of Michigan, Harvard, University of Florida, Tulane, Cornell, and The Ohio State University achieved a higher ranking.

The NLU collection was also listed as thirteenth of the twenty largest collections by lot, thirteenth in regard to cataloging activity, fourth in current yearly collection growth, eleventh in larval holdings, twentieth in species holdings, and eleventh in computerization of cataloged lots. Of all educational institutions surveyed, Northeast Louisiana University ranked first in the number of students receiving M.S. degrees (55) in collection-based research.

Northeast Louisiana University Herbarium. The Northeast Louisiana University Herbarium has grown from 250 specimens in 1966 to a total of 394,800 in 1997. The collection contains over 153,200 specimens collected by *R.Dale Thomas*, Herbarium curator. It also contains vouchers from M.S. thesis studies and specimens received on exchange from over 290 different herbaria from around the world. The NLU Herbarium houses the world's largest collection of *Ophioglossum*.

You are encouraged to see these facilities at our annual meeting at Northeast Louisiana University.

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POSITIONS AVAILABLE

The Department of Biology, Northeast Louisiana University (NLU) is seeking applicants for three positions. All positions begin in August 1998. NLU is a state-assisted institution with about 10,500 students, 400 biology undergraduate majors and 30 graduate majors. The Department of Biology employs 20 full-time faculty with a broad range of research interests. For more information on the department, NLU and the Monroe area, visit us at www.nlu.edu.

DEPARTMENT HEAD

Search re-opened. Applicants must possess Ph.D. and record of active research and external funding. The successful candidate will possess skills and vision necessary to facilitate department development efforts. Salary commensurate with experience. Send curriculum vitae, statements of administrative philosophy, research needs, teaching interests and three letters of recommendation to Department Head Search Committee.

FISHERIES BIOLOGIST/FRESHWATER FISH ECOLOGIST

Assistant Professor, tenure-track position. Must possess Ph.D. and have research experience in freshwater fish population or community ecology with management applications in reservoirs, large river systems, bayous or wetlands. Applicants will be expected to develop an independent externally funded program involving undergraduate and M.S. students. Preference will be given to candidates with a strong record of external funding and evidence of working effectively with federal, state and private agencies. Teaching responsibilities will include introductory biology, fisheries, limnology and possibly population biology. Send curriculum vitae, transcripts, statements of teaching philosophy and research needs, and three letters of recommendation to Fisheries Biologist Search Committee.

For more information on the Department Head or Fisheries Biologist positions, contact Frank Pezold at (318) 342-1794 or bipezold@alpha.nlu.edu.

DEVELOPMENTAL BIOLOGIST

Assistant Professor, tenure-track position. Applicants must possess a Ph.D. and an active research program in a related field. Responsibilities include upper-division courses in embryology and histology, introductory courses for majors and non-majors and development of a research program involving masters- and undergraduate-level students. Send curriculum vitae, statements of teaching and research interests and three letters of recommendation to Developmental Biology Search Committee.

For more information on developmental biologist position contact bisearch@alpha.nlu.edu

Screening begins March 13, 1998 for Department Head, March 15, 1998 for faculty positions. Faxed materials accepted.

Address for all committees is:

Department of Biology
Northeast Louisiana University
Monroe, LA 71209-0520

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opportunity/affirmative action employer.
Minorities and women are encouraged to apply.

ABSTRACTS

- 1 BEDDINGFIELD, STEVEN D AND JAMES B. MCCLINTOCK. University of Montevallo and University of Alabama at Birmingham - Growth, reproduction, and population characteristics of *Lytechinus variegatus* from three contrasting habitats.

Population densities, spatial distributions, size frequencies, growth rates, and reproductive activity of three sub-populations of *Lytechinus variegatus* inhabiting disparate microhabitats in St. Joseph's Bay, Florida, were investigated over a two-year period. Densities of sea urchins fluctuated seasonally and were significantly higher in a *Thalassia testudinum* seagrass bed than on a sand flat and in a seagrass bed of *Syringodium filiforme*. Aggregations of adult sea urchins were observed on the sand flat in the fall and winter months and were well correlated with patchy distributions of food resources. Juvenile sea urchins exhibited significant aggregations at all sites. A significantly higher number of sea urchins near the asymptotic size were observed at the *S. filiforme* site. Estimates of growth based on size frequency data and measurement of growth bands of lanterns, suggest that *L. variegatus* in St. Joseph's Bay attain a mean test diameter of 35 mm in one year and generally live to only two years of age. Gonad indices indicate bi-annual spawning events in the spring and fall. Juvenile recruitment events occurred following fall spawning of adults. Recruitment was not successful following the spring spawn. Lack of juvenile recruitment success may be due to lowered salinities in spring months. Field tethering experiments indicate relatively higher predation on sand habitat as compared to seagrass habitats. In the laboratory, aggregated juveniles experienced a lower incidence of predation than solitary juveniles. Both biotic and abiotic factors appear to influence the structure of *L. variegatus* populations in shallow bay environments.

- 2 GATEWOOD, MELISSA. Department of Biology, Furman University, Greenville SC 29613 - An investigation of distribution patterns in 31 freeze-branded bottlenose dolphins (*Tursiops truncatus*) along the North Carolina coast using photo-identification techniques.

Examination of stock structure is important in resolving issues of depletion and conservation of the coastal population of bottlenose dolphins (*Tursiops truncatus*) in waters near Beaufort and Wilmington, North Carolina. The animals used in this study were thirty-one dolphins who were captured, freeze-branded, and examined during a health assessment in the Beaufort area in 1995. Using photo-identification techniques, some of these animals have been seen and studied since 1987, while others have only been studied from the assessment in 1995 through the summer of 1997. Results from sighting data over this ten-year period divided the dolphins into three categories: those seen in Beaufort in the summer and winter, those seen in Beaufort in the summer and in Wilmington in the winter, and those seen in Beaufort in the summer and not seen in either location in the winter. This suggests that these animals have varying residency and migration patterns, but many of these sightings occurred only once in a season, leaving unanswered questions as to where the animals are in the other months. Confidence in this conclusion would be higher with increased survey effort and continued long-term research using satellite telemetry in addition to photo-identification.

- 3 PETERS, JEFFREY L. and GWENDA L. BREWER. Frostburg State University - Pursuit flight activity of male Gadwall (*Anas strepera*).

Pursuit flights, when one or more males pursue a breeding pair, are a common activity during the breeding season of waterfowl. Gadwall (*Anas strepera*) frequently participate in these flights, which are suggested to have both territorial and sexual functions. In the latter case, males pursue females in an attempt to inseminate them via extra-pair copulations. This study compares the differential participation in pursuit flights of male Gadwall that are alone on the pond and those that are attending a female. Observations of pursuit flight activity were conducted during the breeding season, 28 May to 1 July, 1997, in the prairie pothole marshes of Towner County, North Dakota. Preliminary results suggest that there is a high correlation between number of morning pursuit flights (those coinciding with the potential insemination window) and number of females initiating nesting in weekly periods. Male males seem to expend more effort in these flights than do attending males by participating in more flights that are longer in duration. These preliminary results suggest that some pursuit flights may have a sexual function, and that males may be partitioning mate-guarding and pursuit of females.

- 4 HARPER, ERIKA¹, CATHERINE HUNTER¹, IRENE KOKKALA², AND DENNIS HANEY¹.
¹Department of Biology, Furman University, Greenville SC 29613 and ²Department of Biology,
 North Georgia College and State University, Dahlonega GA 30597. -The effects of salinity on
 chloride cell proliferation in *Cyprinodon variegatus*.

Cyprinodon variegatus is a common coastal resident of the western Atlantic Ocean and Gulf of Mexico. This species is extremely euryhaline, and can be found in ambient salinities ranging from freshwater (0 ppt) to extreme hypersalinity (>140 ppt) throughout its range. Fish used in this study were obtained from a Gulf of Mexico salt marsh near Cedar Key, Florida. This study examined the effects of salinity on chloride cell proliferation and growth on individuals acclimated in the laboratory to salinities from 0 ppt to 80 ppt. Gills were removed from each fish, preserved in glutaraldehyde, dehydrated, and stored in 70% ethanol prior to histological analysis. Gills were then embedded in JB4 and cut into 6 µm sections utilizing a microtome equipped with a glass knife. Sections were then placed on glass slides, stained with toluidine blue and examined for chloride cell density and size. As salinity increased, chloride cell density and size increased dramatically, with up to a 120% increase observed in fish acclimated to 2 ppt compared to fishes acclimated to 80 ppt. Initial assessment indicates that chloride cell proliferation negatively impacts respiratory cell numbers as well. These results correlate well with previously observed declines in metabolism under hypersaline conditions.

- 5 DEVINNEY, PATRICIA, E.J. DAVIS AND DONALD SPARLING. Bowie State University and
 Patuxent Wildlife Research Center, Laurel, MD 20708 - Assessing restored depressional
 wetlands in the mid-Atlantic states.

One of the tools that holds promise for wetland ecology is the concept of an Index of Biological Integrity (IBI). These indices measure various biological components of an ecosystem. The underlying premise of such indices is that the organisms inhabiting an ecosystem are reliable and quantifiable measures of that ecosystem's health. Before an IBI can be put into practice for the Mid-Atlantic restored depressional wetlands, *it must first be developed*. The objectives of this study are to: develop a series of metrics (IBI) based on biological factors for restored depressional wetlands located in the Mid-Atlantic states; validate and compare these metrics by relating them to other physical and chemical factors that are traditionally accepted as affecting wetland health (the goal of this objective is to identify those metrics which most reliably reflect wetland health and can be measured within budgetary and time constraints typical of governmental monitoring efforts); and to develop a set of sampling protocols that will standardize methodologies used in the data gathering and analysis of these metrics. Efforts are focused on approximately 24 restored depressional and 6 natural (to be used for reference and control) wetlands located in agricultural setting within the Eastern Shore of Maryland and Delaware.

- 6 LANCASTER, DAVID A. AND TERRY RICHARDSON. Department of Biology, University of
 North Alabama, Florence, AL 35632-0001-Distribution and abundance of non-chironomid insects in
 a freshwater wetland.

Research on wetland invertebrates has been limited partly because these ecosystems are a mixture of both aquatic and terrestrial habitats and require multiple sampling techniques. Samples were taken monthly from a *Juncus* sp. marsh using an Ekman grab in aquatic rivulet areas (permanently submerged habitat) and cores in the semiaquatic *Juncus* tussocks (variably submerged, saturated, or dry) to compare predominance of non-chironomid insect groups. Average density of Insecta was 43,140/m² in the *Juncus* tussocks compared to 11,325/m² in the rivulets. The most prevalent taxa in the tussocks were detritivorous Collembola (18,917/m²) and predaceous Ceratopogonidae (13,145/m²) representing 74% of the total insects collected. In the rivulets, larval stage predators were the predominate taxa with ceratopogonids representing 91% of insects collected. Both larvae and adults were found in tussocks in approximately equal numbers. Semiaquatic and terrestrial insect groups (e.g., collembolans, carabids, and curculionids) dominated the tussocks while aquatic groups (e.g., ceratopogonids and dytiscids) dominated the rivulets.

- 7 LOCKHART, BRIAN R.¹, JAMES E. KELLUM¹, LYNNE C. THOMPSON¹, PHILIP A. TAPPE¹,
 DAVID G. PEITZ¹, ROBERT C. WEIH, JR.¹, EDMOND J. BACON², and HAL O. LEICHTY¹.
¹Arkansas Forest Resources Center, School of Forest Resources, University of Arkansas, Monticello,
 AR 71656 and ²Division of Mathematics and Sciences, University of Arkansas, Monticello, AR
 71656 -Impacts of reproduction cutting methods in a bottomland hardwood ecosystem: a multi-
 disciplinary study.

Historical alterations and conversions of bottomland hardwood ecosystems have focused increased interest on understanding impacts of various reproduction cutting, or harvesting methods on remaining forested wetlands. Therefore, a multi-disciplinary research project was initiated through the Arkansas Forest Resources Center in cooperation with Anderson-Tully Company to determine the long-term impacts of cutting methods on flora and fauna of a bottomland hardwood ecosystem along the Mississippi River. Treatments, each 20 ha in size and replicated three times, included clearcutting and selection cutting along with unharvested controls. Treatments were installed during the winter of 1995-1996. Floral study components include tree species composition, regeneration dynamics, and herbaceous vegetation. Faunal study components include birds, insects emphasizing ground beetles, amphibians, and reptiles. Other wildlife habitat structural components include coarse woody debris, vertical structure, horizontal structure, and canopy coverage.

- 8 ROBERTSON, MIKE S. AND KIRK WINEMILLER. Dept. Wildlife and Fisheries, Texas A&M University, College Station, TX 77843 - Effect of an introduced piscivore on the native fish assemblage in the Devils River, Texas.

The upper and middle regions of the Devil's River, Val Verde county, Texas, remain a relatively pristine aquatic ecosystem in the arid southwest of North America, however, in recent years there has been a decline in certain species, and four fish species in the area are currently listed as threatened by the state. These include: *Dionda diaboli* (Devil's River minnow), *Cyprinodon eximius* (Concho pupfish), *Etheostoma grahami* (Rio Grande darter), and *Cyprinella proserpina* (proserpine shiner). *Micropterus dolomieu* (smallmouth bass) is an introduced predator that may have contributed to the decline of certain native fishes in the Devils River. We are testing the impact of this exotic on the native community with a press perturbation experiment within two stream reaches, an experimental and an unmanipulated control. Seven meso-habitats are being monitored in each reach. The individual habitats are sampled bi-monthly, and bass are removed from the experimental reach following each sample. Snorkle surveys show that the smallmouth bass removal has significantly reduced bass numbers. Preliminary data suggests a shift in relative abundances of some fish species in the manipulated stream reach compared to the control reach. Initially, *Cyprinella proserpina*, *Dionda argentosa*, and *Notropis amabilis* appear to be the most affected by the presence of the bass, and *Cyprinella venusta* appears to be the least affected.

- 9 BETTS, TASHAUN C.¹, E.J. DAVIS¹ AND KEANG PENG SONG². ¹Bowie State University, 20715 and ²Dept. of Microbiology, National University of Singapore 119260, -Characterizing the genetic differences among pathogenic and non-pathogenic strains of *Clostridium difficile*.

There are many microorganisms that have the ability to produce toxins that cause damage to eukaryotic cells. Several species of Clostridia possess this toxin producing ability, including the gram positive anaerobe *C. difficile*. The pathogenic strains of *C. difficile* produce two toxins, A and B, which have been determined to be the causative agents for Pseudomembranous colitis (PMC). PMC is a potentially fatal gastrointestinal disease in humans, causing severe inflammation of the colon. However, non-pathogenic strains do not produce any toxin. The objective of this research is to find out the factors responsible for this difference. Preliminary data indicated that the non-pathogenic strains may not contain the toxin genes. A genetic analysis was therefore done here to compare the genomic DNA between the pathogenic and non-pathogenic strains. Seven strains of *C. difficile* were cultured under anaerobic conditions (pathogenic: 10463, 9018, 9004 non: 20307, 19126, 11186, 9689). The genomic DNAs of each sample were extracted, and gel electrophoresis and photospectrometric readings were used to determine the quality and concentration of DNA. Each sample underwent a series of restriction enzyme analysis. Southern Blot was done using three different γ -ATP ³²P labeled oligonucleotide probes. Genetic differences among the pathogenic and non-pathogenic strains of *C. difficile* were found through this analysis. Further research is needed to determine the magnitude of these differences.

- 10 DHAWAN, VIJENDER AND DIANE S. SWAFFAR. School of Pharmacy, Northeast Louisiana University, Monroe, LA 71209 - Correlation between altered topoisomerase II enzymatic activity and phenotypic changes associated with cancer cells.

Topoisomerase II (topo II) is an essential nuclear protein which plays a vital role in DNA replication, recombination and chromatid separation during cell division. These functions are attributed to topo II's ability to reduce torsional strains associated with supercoiled DNA. Topo II is an important target of many anticancer drugs, and any alteration of this target may influence the sensitivity of cancer cells to drugs targeting topo II. Currently, in our laboratory we are evaluating

the changes in topo II's catalytic activity in various cancer cell lines. For this purpose, nuclear proteins were isolated from breast cancer cell lines - MCF-7 and its resistant counterpart - MCF-7/ADR; a melanoma cell line -B16V and its resistant phenotype - B16VDXR; and a DNA repair deficient Chinese Hamster Ovary (CHO) cell line, xrs-6, and BR1 - a DNA repair proficient CHO cell line. These nuclear extracts were examined for their topo II activity by evaluating their ability to decatenate kinetoplast DNA, a highly catenated network of DNA monomers. Results indicate that resistant phenotypes, in general, have lower topo II activity as compared to their sensitive parent cell lines. The xrs-6 cell line had slightly elevated activity of topo II than BR1 cells. These results suggest that altered topo II levels in cancer cells may play an important role in determining the phenotype of various cancer cells and in distinguishing sensitive cell lines from resistant ones.

- 11 DOUCET, JOHN P.^{1,4}, MEG DEANGELIS², Z. DEN², STACY DRURY², MARK BATZER³, BRONYA J. KEATS¹, AND PRECOTT DEININGER⁴. ¹Dept., Biological Sciences, Nicholls State University, Thibodaux, LA 70310 and Depts. ²Biometry and Genetics, ³Pathology, and ⁴Biochemistry and Molecular Biology, LSU Medical Center, New Orleans, LA 70112 - Gene Discovery in Acadian Usher Syndrome.

The Usher Syndromes are heritable diseases that exhibit both deafness and blindness in affected individuals. Type I Usher Syndrome, characterized by profound congenital deafness with vestibular involvement, occurs in several populations around the world, including a small group of Acadian descendants from southwestern Louisiana. Genetic analysis localizes the gene for Acadian Usher Syndrome (USH1C) to a one million-base region on the short arm of chromosome 11 (p15-p14.1). About 20-50 genes are predicted to lie in the USH1C candidate region, and expression of only 4-10 of these are predicted to play a role in both hearing and vision. Mutation analysis of these 4-10 inner ear- and retina-specific genes is predicted to demonstrate a causative gene for Acadian Usher Syndrome. By exon trapping genomic clones containing the USH1C region, we have identified a previously cloned gene, the human NEFA (Nuclear, EF-hand, Acidic) gene. RT-PCR amplification of NEFA mRNA purified from cell lines derived from two affected individuals produced an approximately 1300-base pair cDNA, consistent with the reported size of the NEFA coding region. Sequence analysis of this putative NEFA cDNA revealed 100% identity to the base sequence of NEFA previously cloned from non-affected source. These results (1) localize the human NEFA gene to 11p15-p14.1 and (2) suggest that the causative defect of Acadian Usher Syndrome lies outside the coding sequence of the human NEFA gene.

- 12 FLICKINGER, SHANE T., AND WILLIAM L. SEDDON Dept. of Biology, Frostburg State University, Frostburg, MD 21532 - Long term maintenance of *in vivo* function in cultured channel catfish hepatocytes.

Hepatocytes were isolated from channel catfish (*Ictalurus punctatus*) using a collagenase-free perfusion system that takes advantage of the chelating properties of EDTA (ethylenediaminetetraacetic acid). Initial viability's of hepatocytes isolated by this method are routinely in excess of 95% and cells have been maintained in culture over 30 days in osmotically corrected L-15 medium at physiological pH. Hepatocytes organize to form structures that resemble those found in the intact liver without serum or hormone additions to culture medium. Channel catfish hepatocytes maintain levels of malate dehydrogenase and lactate dehydrogenase activity, total protein, and albumin production similar to those measured *in vivo* and in freshly isolated cells. Cell attachment, but not viability, enzyme activities, or morphology, was enhanced by seeding cells onto charge modified PrimariaTM culture plates.

- 13 LEONG, LAUREL L. Y., KENNETH G. WILSON, AND NANCY L. SMITH-HUERTA. Dept. of Botany, Miami University, Oxford, OH 45056 - A comparison of gene expression between wild-type *Clarkia tembloriensis* and the one-whorl homeotic mutant, *crinkled petal*.

The majority of floral homeotic genes govern the development of two adjacent whorls of organs in a flower. However, the crinkled petal gene of *Clarkia tembloriensis* (Onagraceae) is one of a small number of known floral homeotic genes which causes homeosis in one organ whorl only. Plants mutant for the *crinkled petal* gene have normal sepals but produce hybrid sepal/petal structures ("crinkled petals") in the petal whorl of their flowers. Thus, it is expected that gene expression for the petal whorl of mutant plants will show similarities to that of both sepals and petals of wild-type plants. Using cDNA from different tissues, and probes from *Petunia* and *Arabidopsis* genes for similar homeotic floral phenotypes, gene expression was compared between wild-type, mutant, and F1 hybrid *Clarkia* leaves, sepals, and petal-whorl structures. Studying naturally-occurring mutations such as *crinkled petal* may contribute to our knowledge of the relationships between the different floral organs and may provide insight into the evolution of the flower itself.

- 14 YAMASHITA, TSUNEMI AND JIAN QIN. Dept. Biology, Northeast Louisiana University, Monroe, LA 71209 - PCR detection of *Mycobacterium leprae* in the armadillo, *Dasypus novemcinctus*.

Tissue samples from native armadillos were surveyed for the presence of *Mycobacterium leprae* with PCR. Approximately 78% of armadillos produced positive results. Between males and females, the frequency of infection was similar in ear, abdominal skin, and inguinal lymph nodes; however, skeletal muscle infection frequencies showed a significant difference. We suggest that samples taken from the ear and abdominal skin can be an accurate method to detect early *M. leprae* infection in armadillos. Furthermore, a dry ice freeze/thaw extraction procedure with Proteinase K appears to produce a sample suitable for PCR amplification.

- 15 DOVER, SHANNON L.^{1,2}, SARAH M. KATH², D.K. KENNEDY³, MIKE L. KENNEDY³, AND MAZIN B. QUMSIYEH². ¹Department of Biology, Furman University, Greenville SC 29613, ²Department of Pathology, Duke University Medical Center, Durham NC 27710 and ³Department of Biology, University of Memphis, Memphis TN. -Robertsonian polymorphism in western Tennessee populations of *Blarina carolinensis*: Not all translocations are deleterious.

We have documented eight Robertsonian translocations in western Tennessee and northern Mississippi in populations of *Blarina carolinensis*. The normal diploid number for this species is 46, but the Robertsonian translocations account for the varied diploid number of 33-40 in these areas. Heterozygosity for these rearrangements is found in 70-80% of animals from four localities in western Tennessee and one locality in Mississippi, while no rearrangements have been detected east of the Tennessee river. Other species, including *Sorex* and *Cryptotis* are not affected in this manner. Hardy-Weinberg equilibrium was met in each locality for which sample numbers permitted analysis. It is not clear why heterozygous individuals do not show any reduction in fertility as reported in humans and murids with Robertsonian translocations, and it remains to be investigated why such forces would affect only one shrew species and not others.

- 16 STANTON, KATHLEEN AND WILLIAM L. SEDDON. Frostburg State University - Combined effects of dietary lipids and environmental temperature on growth, protein and lipid composition of channel catfish (*Ictalurus punctatus*) fingerlings.

Channel catfish (*Ictalurus punctatus*) fingerlings with an average initial weight of 2.59g±0.30 were held at 15° and 25°C for a 10 week period and fed three diets differing in lipid source and percent total lipids. The basal diet contained 5% lipid and the experimental diets were supplemented with an additional 5% of either long chain (LCT) or medium chain triglycerides (MCT). Each of eighteen aquaria were stocked with 20-25 fingerlings. Triplicate groups of fish were fed each of the diets at both of the temperatures ad libitum. The data were evaluated statistically by application of Duncan's multiple range test. Fish raised at 25°C gained significantly more weight (P<0.5) than fish at 15°C over the 10 weeks. Fish fed the basal diet gained significantly more weight (P<0.5) than fish fed the diet supplemented with MCT; the LCT supplemented diet did not differ significantly from either the basal diet or the MCT supplemented diet. Percent carcass fat was significantly greater (P<0.5) at 25°C than 15°C. Condition factor, hepatosomatic index, and carcass percent protein were significantly greater (P<0.5) for fish at 15°C. Percent moisture and percent ash did not differ significantly (P>0.5) between any of the experimental groups.

- 17 GRAYSON, JACKIE C. AND ANN M. FINDLEY. Dept. of Biology, Northeast Louisiana University, Monroe, LA 71209 - Parasitemia in turtles from northeast Louisiana.

Peripheral blood samples collected from various turtle species including *Chelydra serpentina serpentina*, *Trachemys scripta elegans*, and *Pseudemys concinna* were examined for the presence of intraerythrocytic parasites. *Haemogregarina* sp. and a cytoplasmic inclusion of possible viral origin were consistently observed in all turtles. Total percent red blood cells infected and differential white blood cell counts are presented for Layton Farm Pond (NLU Campus) and Black Bayou Lake (Ouachita Parish) collection sites. Differences in infection rates are shown as a function of the particular turtle species, the size of individual turtles, and the male/female sex ratio of animals sampled. Apparent seasonal variations in parasitemia in turtles bled during the spring, summer and fall months are discussed.

- 18 BOOTH, ROBERT K. AND JOHN AVERETT. Georgia Southern University - Causes of *Quercus virginiana* decline and recommendations for management at Fort Stewart Military Base, GA.

Fort Stewart Military Base is located in southeast Georgia and incorporates portions of Bryan, Evans, Liberty, Tattnall, and Long Counties. Scattered oak groves, dominated by *Quercus virginiana* (live oak) are distributed throughout the base. Concern over the dieback and health decline of *Quercus virginiana* populations on Fort Stewart prompted investigations into possible causes. Previous work indicates no significant difference in phosphorus, potassium, calcium, magnesium, pH, and organic matter levels in the soil around healthy and declining trees. Results of the current study suggest that soil compaction and vehicle traffic are dominant factors contributing to live oak decline on the military base. Management recommendations are outlined.

- 19 CONNER, WILLIAM H. AND L. WAYNE INABINETTE. Baruch Forest Science Institute, Box 596, Georgetown, SC 29442 - Response of three forested wetland species to flooding and competition.

Due to the subtropical nature of the southeastern U.S. coastal plain, exotic species have frequently become naturalized and become pests. Some species, which may not be as aggressive or obvious of a problem at this time, may yet become a pest. One of these is Chinese tallow tree (*Sapium sebiferum* Roxb.), introduced from eastern Asia in the late 1700s or early 1800s to the South Atlantic and Gulf coastal plain. It has become naturalized along the coast from southern Texas to North Carolina. In Texas and Louisiana, this species has become a very serious competitor to the native species in stream swamps, forming very dense monotypic stands. Chinese tallow is also a problem in Florida, and an anti-tallow campaign is currently under way to prevent further infestations. In this experiment we examined the competitive relationships between seedlings of baldcypress (*Taxodium distichum* (L.) Rich.), water tupelo (*Nyssa aquatica* L.), and Chinese tallow in full sun environments under flooded and drained conditions. In the drained treatment, leaf biomass of Chinese tallow was 2-4 times greater, and stem biomass was 1.5-10 times greater than water tupelo and baldcypress, respectively. Under flooded conditions however, Chinese tallow was not very successful, and water tupelo outgrew baldcypress. In drier bottomland areas, Chinese tallow may successfully compete with the native coastal forest species.

- 20 HINKLE, C. ROSS, DUANE DeFRESE, PAUL A. SCHMALZER, DAVID COX, RANDY PARKINSON, MARGARET HAMES, and ANNE BIRCH. Environmentally Endangered Lands Program, Brevard County, Melbourne, FL 32899. - From land acquisition to management, a local conservation program matures.

The Brevard County Environmentally Endangered Lands Program was established by public referendum in 1990. Since then, over 13,000 acres of relatively pristine lands have been acquired. Acquisition partners have included the Florida Conservation and Recreational Lands Program, the Florida Community Trust, the St. Johns River Water Management District, and the North American Wetlands Conservation Council. Ecosystems protected include scrub, pine flatwoods, maritime hammocks, mesic and hydric hammocks, hardwood swamps, freshwater wetlands, and estuarine wetlands. A Sanctuary Management Manual has been developed to guide the management of this sanctuary network. Management is based on the concept of maintaining biodiversity throughout the sanctuary network, while using Principles of Conservation as a basis for integrating passive recreational use.

- 21 KELLY, K.A., K.K. DENLEY, S.P. FAULKNER AND R.A. STEWART. Delta State University. - Woody thicket community composition and structure at abandoned tenant house sites in the Yazoo-Mississippi Delta floodplain.

In a survey of thickets at 12 abandoned tenant farm house sites in northwestern Mississippi, woody species were rated for relative abundance using a scale of 1 to 5. A-horizon soil samples were taken under canopies and within fields or non-thicket areas adjacent to the study sites. Sites are characterized by patchy distribution of mainly animal-dispersed species, notably the exotics *Melia azedarach*, *Broussonetia papyrifera*, *Albizia julibrissin*, *Lonicera japonica*, and the native *Rhus glabra*. This pattern contrasts with the more heterogeneous distribution of wind-dispersed native species (*Populus deltoides*, *Fraxinus pennsylvanica*, *Liquidambar styraciflua*, and *Baccharis halimifolia*) that commonly establish on local abandoned fields. Estimated areas of the sites ranged from 0.02 to 0.5 ha. Species diversity increased

as area increased. Soil organic matter and nutrients were higher within study sites which typically supported substantial O-horizons. Abandoned house sites in the Yazoo-Mississippi Delta floodplain show a successional pattern unlike natural old field succession for the region: dense island-like thickets develop largely from exotic species. These areas may provide shelter and refuge for birds and other animals in an otherwise predominately agricultural landscape.

- 22 LANGLEY, SUSAN K.¹, KAREN HUMES², AND HEATHER M. CHESHIRE¹. ¹Dept. Botany, North Carolina State University, Raleigh, NC 27695 and ²Dept. Geography, University of Oklahoma, Norman, OK 73019 - A comparison of single date and multitemporal satellite image classifications in a semi-arid grassland.

The USDA established the Jornada Experimental Range, located in the Jornada basin of southern New Mexico, near Las Cruces, in 1912. Changes in the spatial distributions of grasses and shrubs have been documented since 1858. During the past century, this site has become increasingly dominated by shrubs like mesquite, creosote, and tarbush. Remotely sensed image data from the Jornada site was used to produce a phenologically-based classification map delimiting the current ranges of the dominant species. Landsat Thematic Mapper (TM) satellite image data were collected on three dates (May 1995, September 1995, and February 1996) at this semi-arid grassland. Image data for each date were independently classified using three spectral bands (3, 4, and 5). Multitemporal classifications using combinations of the band data from the three dates were also produced. The resulting classifications were assessed for accuracy using a limited number of field based plots as reference. Results of the single date and multitemporal classifications are presented along with results of the accuracy assessments. Preliminary results indicate that single date image classifications are better for classifying current vegetation types in this geographic region.

- 23 RITCHIE, JERRY C.¹, BREAN W. DUNCAN², DAVE R. BREININGER² AND C. ROSS HINKLE². ¹USDA-ARS Hydrology Laboratory, BARC-W Bldg-007, Beltsville, MD 20705 and ²The Dynamac Corporation, Mail Code: DYN-1, Kennedy Space Center, FL 32899 - Application of airborne laser altimetry to measure vegetation properties at Kennedy Space Center, Florida

An airborne laser altimeter was used to measure surface features and properties of the landscape at Kennedy Space Center, Florida. The laser altimeter makes 4000 measurements per second with a vertical resolution of 5 cm. A measurement is made every 5-6 cm along the ground. Data from 10 flightline transects were analyzed. Total length of these transects was 40 km. Maximum vegetation height measured was 20.5 m. For vegetation greater than 0.5 m tall, average vegetation height was 3.4 ± 1.3 m along these transects. 90% of the vegetation along the transects was less than 6.5 meters tall and 95% was less than 10 m tall. Plant cover along these transects for vegetation greater than 0.1 m tall was 92.7 ± 2.7 % and for vegetation greater than 0.2 m tall was 79.4 ± 6.4 %. In other studies laser altimeter measured vegetation canopy height, cover, and distribution have been shown to be highly correlated with ground measurements made using classical line transect methods. Laser altimeter measurements of the landscape can provide detailed data on landscape surface features and properties for understanding the patterns of distribution of vegetation on natural and agricultural landscapes.

- 24 TRISEL, DONALD E., AND DAVID L. GORCHOV. Fairmont State College, Fairmont, WV and Miami University, Oxford, OH - Competitive effects of an invasive ornamental shrub, *Lonicera maackii*, on *Acer saccharum* seedlings.

Lonicera maackii, native to northeastern Asia, was introduced to North America as an ornamental plant. Non-cultivated shrubs now occur in numerous parts of the eastern USA. Previous research has shown a reduced herb layer under dense stands of this shrub, thus *L. maackii* may affect natural areas via competition and/or allelopathy. A field experiment was conducted to test the effects of established *L. maackii* on the survival and growth of transplanted *A. saccharum* seedlings. The experiment examined competition for light (by removing *L. maackii* shoots) and competition for below-ground resources (by trenching around transplanted seedlings). *Acer* seedling survival was significantly reduced in the presence of *L. maackii* shoots and roots. With increased competition for light and increased densities of *L. maackii*, surviving *Acer* seedlings grew larger leaves and taller stems. The increased mortality of tree seedlings indicates that *L. maackii* may negatively impact the natural regeneration and cause a loss of biodiversity in natural areas invaded by this shrub.

- 25 FARMER, SUSAN B. AND EDWARD E. SCHILLING. University of Tennessee at Knoxville - Toward an understanding of the global phylogeny of the Trilliaceae.

Trillium, *Paris*, *Kinugasa*, and *Daiswa* are genera of flowering herbaceous plants found in temperate mixed forests which comprise the family Trilliaceae sensu Takhtajan. Confusion has arisen about the composition of the group: Are these plants in reality a single genus, or are the traditional generic groupings correct. If the traditional genera are correct, what are the relationships within this group; the taxa from the Trilliaceae included in a recent study using DNA sequences from the *rbcl* gene showed far less differentiation than for other generic groups included in the study. In addition, even though the plants are morphologically distinct and quite similar, systematists disagree as to whether the plants comprise a separate family or should be included within a larger family such as the Liliaceae sensu lato. Regardless of the familial placement of the taxa, the closest relatives to this group of taxa still need to be determined: Is it *Medeola* or *Scoliopus* as long thought, or is it indeed the Melanthiaceae as is indicated by recent molecular studies. Preliminary results from a cladistic analysis of morphology show that *Paris* and *Trillium* are distinct entities, but *Paris*, *Kinugasa*, and *Daiswa* are not separable.

- 26 BATTAGLIA, LORETTA L. AND REBECCA R. SHARITZ. University of Georgia, Savannah River Ecology Laboratory-Disturbance increases environmental heterogeneity in a southeastern floodplain forest

Forest regeneration following disturbance may be influenced by disturbance-generated environmental heterogeneity. In bottomland hardwood forests, windstorms can result in a complex array of light and flooding microsite conditions that potentially affect regeneration patterns. Both greater variation and reduced spatial autocorrelation could contribute to light and flooding heterogeneity. In 1989, thirty plots were established along a post-hurricane disturbance gradient in the old-growth bottomland hardwood forest of the Congaree Swamp National Monument to examine the pattern of light and microtopographic heterogeneity. In each plot, light availability was estimated using hemispherical photographs taken along transects at a variety of spatial intervals and at 25 randomly located points. Microtopography was measured at different spatial intervals along transects and at random points using a laser surveying unit. Spatial autocorrelation of light and microtopography was negatively correlated with disturbance intensity; variance of both factors increased along the disturbance gradient. This hurricane-generated variation and spatial arrangement of light and microtopography could increase microsite heterogeneity.

- 27 CUSHMAN, LAARY J. AND HARRY E. SHEALY, Jr. - University of South Carolina-Aiken - Tree ring studies of *Taxodium distichum* L. and the effects of different community types upon their growth rates.

Within the South Carolina Congaree Swamp National Monument, three separate forest communities were studied to compare the relative growth rates of *Taxodium distichum* L. (Bald Cypress). Dendroecological techniques were performed on the Bald Cypress within three separate forested areas. The cypresses were located in a bottomland hardwood area, a mesic hardwood area, and an inundated swamp area. The Bald Cypress is very responsive to environmental changes within these communities, such as floral composition, flooding, and drought. Such disturbances produced different effects in growth rates upon the Bald Cypress and other flora. Using tree ring width variations, the research provides an observation of the effects of community types to further the understanding of *T. distichum* growth rates. Differences in the Bald Cypress growth rates for the past 300+ years were observed within each separate community type.

- 28 ALLEN, BRUCE P., ERIC F. PAULEY, and REBECCA R. SHARITZ. Savannah River Ecology Laboratory and Coastal Carolina University - Long-term hurricane influences on liana community structure in a southeastern floodplain forest.

During the eight years since Hurricane Hugo devastated portions of the old-growth floodplain forest of the Congaree Swamp National Monument, liana communities have responded in several ways. Liana populations were studied across hydrologic and disturbance gradients in this forest. Ten 1-ha plots were established in 1989-90, re-sampled in 1994 and again in 1998. In heavily damaged areas, liana density initially decreased dramatically but showed signs of recovery eight years after the hurricane. Stem densities of *Rhus radicans* decreased by 55 % initially. In less disturbed areas, vine communities have

been quite stable in the years since the hurricane and continue to be with recruitment offsetting mortality. Liana communities were composed primarily of *Rhus radicans* (87 stem/ha), *Vitis* sp. (27 stem/ha), *Parthenocissus quinquefolia* (20 stems/ha), and *Campsis radicans* (10 stems/ha). Liana diameter growth rates continue to reflect size- and species-specific differences.

- 29 WHITBECK, JULIE L., J. BARMORE, M. D. KING and B. STEVENS. EEO Biology, Tulane University, New Orleans, LA 70118 USA - Impacts of soil-based refinery pollutants on bottomland hardwood forests: responses at organism, population and community levels of organization.

Bayou Trepagnier, an ancient tributary of the Mississippi River, received heavy metal- and hydrocarbon-containing effluent from an oil refinery for over 60 years, resulting in substantial accumulation of these materials in its sediments. Dredging of the bayou during this time and the deposition of its sediments as 'spoil' banks several meters from the edge of the waterway brought these pollutants into the terrestrial system. An examination of the terrestrial vegetation between the spoil banks and the Bayou Trepagnier waterway indicates that 1) several plant species at the polluted site accumulate heavy metals, 2) populations of the dominant trees have similar age structure to those at a nearby reference site, except in the youngest age classes, and 3) while woody community diversity, stem density and basal area are similar to those of the reference site, 4) herbaceous community diversity is greater yet biomass is much lower at the contaminated site. We synthesize these observations to evaluate at what level(s) of organization these pollutants are shaping community structure and ecosystem productivity.

- 30 BAILEY, PAMELA and DAN K. EVANS. Herbaria, Marshall University, West Virginia and Catholic University, Quito, Ecuador-- A medicinal plant survey in public market places of Ecuador.

A medicinal plant survey of public market places in Ecuador was conducted during the summer of 1997. Ten cities in the Andean and coastal areas were included in the study. Ethnobotanical information including local plant names, medicinal uses, method of preparation, dosage and names of market vendors were recorded for each herbarium collection. Photographs were made of fresh plant material, vendors and of market places. A total of 117 species representing 43 vascular plant families were recorded in the survey. Of these, 81 species (70 percent) were native to Ecuador while the remaining 35 species were introduced taxa. Collections were organized into 18 categories of medicinal uses. The three categories most represented were: General Tonic and Body Purifier (30 species), Stomach and Digestive Disorder (23 species), and Elimination of Parasites (14 species).

- 31 ALLEN, CHARLES, JOE SAUNDERS, MARAYA GULLETTE, AND MONICA BARROIS. Northeast Louisiana University, Monroe, LA 71209-Identification of seeds from the Watson Brake mound complex in Northeast Louisiana.

Watson Brake is an eleven mound complex in Northeast Louisiana that has been dated to over 5000 calendar years before present. Charred seeds were isolated from the mound and identified. The most frequently occurring seeds were goosefoot (*Chenopodium berlandieri*). A few seeds of marshelder (*Iva annua*) and smartweed (*Polygonum* spp.) were also found. These three species plus canary grass (*Phalaris caroliniana*), little barley (*Hordeum pusillum*), and sunflower (*Helianthus annuus*) are usually reported to be the premaize food complex in eastern North America.

- 32 CHRIS A. FLEMING, RALPH L. THOMPSON, and RUDY A. GELIS, Biology Department, Berea College, Berea, KY 40404 - Wetland and aquatic vascular flora of five reservoirs in the Berea College Forest, Madison and Jackson Counties, Kentucky.

A descriptive floristic survey of the wetland and aquatic vascular plants of five Berea College reservoirs was conducted during the growing seasons of 1995-1997. These reservoirs supply water to the city of Berea and surrounding communities. The six plant habitats described were Vegetated Open Water, Emergent Marsh, Shrub Swamp, Seasonally Dewatered Mudflat, Wet Meadow, and Small Stream with Gravel Bars. Relative abundance for each taxon was determined within each wetland habitat. The annotated species list comprises 272 species, 163 genera, and 66 families; 36 taxa are naturalized. Representative voucher specimens are on deposit in the Berea College Herbarium (BEREA). Species are classified as Equisetophyta (2), Lycopodiophyta (1), Polypodiophyta (4), Pinophyta (1), and Magnoliophyta (164). In the National Wetland Classification Scheme, 146 taxa (53 %) are obligate and facultative wetland species. Several locally rare taxa were found in reservoir habitats; however, none were on the current Kentucky State Nature Preserves Commission endangered and threatened plant list.

- 33 THOMPSON, RALPH L.¹ AND JOHNNY R. SKEESE². Biology Department, Berea College, Berea, KY 40404 and College of Pharmacy, University of Toledo, Toledo, OH 43606 - Vascular flora of Golden and Silver Falls State Park, Coos County, Oregon.

Golden and Silver Falls State Park, 39 km northeast of Coos Bay in Coos County, was established in 1936 to preserve two waterfalls and an old-growth stand of Douglas fir (*Pseudotsuga menziesii*). The 63.6-ha rugged forested tract is situated in the Coast Range Physiographic Province in the Western Hemlock (*Tsuga heterophylla*) Zone. Park elevation ranges from 94 m at the junction of Silver Creek and Glenn Creek to 293 m on ridgecrests. A floristic survey was conducted during June-August 1989, March 1990, May-June 1992, and February-April 1997. Six plant community types were delineated from field reconnaissance by topographic features, physiognomy, and floristic composition. Plant communities are two upland forest types (*Pseudotsuga/Acer/Polystichum* and *Pseudotsuga/Rhododendron/Polystichum*), two riparian forest types (*Alnus/Rubus/Phalaris* and *Umbellularia/Rubus/Polystichum*), exposed sandstone cliffs, and ruderal habitats. Vascular flora consists of 240 specific and infraspecific taxa in 161 genera from 61 families, of which 67 taxa (27.6 %) are non-native. Species are classified into Pteridophytes (12), Gymnosperms (3), and Angiosperms (225). Species richness was greatest in Poaceae (30), Asteraceae (25), Fabaceae (15), Saxifragaceae (12), Juncaceae (11), and Liliaceae (9).

- 34 MARTZ, TARA E. AND DAVID A. FRANCKO. Botany Department, Miami University, Oxford, OH 45056 - Primary productivity at the Old Woman Creek National Estuarine Research Reserve, Huron, OH.

The Old Woman Creek National Estuarine Reserve, located in Erie county, Ohio at the edge of the Western Basin and the southern-most point on the Great Lakes, represents the only freshwater reserve in the NERRS program. Coastal managers and ecologists are both interested in developing a field-based management model that may be implemented by workers in the field and applied to various wetland settings. Knowledge of photosynthetic carbon flow rates are requisite for such modeling, since the products of photosynthesis determine the structure and function of higher tropic levels. Primary production measurements were conducted from June to October, 1997. The ¹⁴C-bottle incubation method was used to measure *Nelumbo lutea* floating leaves, *Potamogeton pectinatus*, epiphytes, and algal productivity. Water chemistry, solar illumination, percent cover, and water depth data allowed for the conversion of short-term rates into whole estuary values for individual dates and for the growing season. An estimation of annual production rates was determined from the growing season photosynthetic carbon budget. This allows the testing of the hypothesis that macrophytes and their attached epiflora and not phytoplankton, as previously believed, are the preeminent primary producer component in OWC.

- 35 CLYDE, JR. GERARD A., JESSICA FRANKS, AND DAVID A. ROLBIECKI. Institute of Applied Sciences, University of North Texas, Denton, TX. - Spatial and Temporal Variability of Chlorides and Sulfates in Lake Texoma.

The U.S. Army Corps of Engineers anticipates being able to decrease sodium and chloride concentrations in Lake Texoma by 45% and calcium and sulfate concentrations by approximately 5% relative to current loadings from the Red River following full implementation of the Red River Chloride Control Project. There are concerns, however, that this could possibly have some deleterious effects on natural resources of the watershed and limnological features of Lake Texoma. Lake Texoma is characterized by a strong salinity gradient. The highest conductivity values are associated with the riverine portions of the Red and Washita Rivers. Historical studies have defined four zones in the reservoir and it is likely that a fifth zone exists in the Washita River portion of the reservoir. This study was designed to test the hypothesis that water quality parameters in Lake Texoma do not change as a result of implementation of chloride control projects in its upper watershed. Spatial and temporal variation of chloride and sulfate concentrations in the reservoir will be discussed.

- 36 KALINSKY, ROBERT G. Louisiana State University in Shreveport - Limnological investigations of a mesoeutrophic lake in northwestern Louisiana.

The physico-chemical characteristics of a mesoeutrophic lake were studied over a period of one year. Vertical analyses of conductivity, dissolved oxygen (DO), light (as PAR and seiche disk), pH, temperature, and turbidity were performed on Harmon Lake located in the East Reservation of Barksdale Air Force Base, Bossier Parish, Louisiana. Harmon Lake is an unusual impoundment in northern Louisiana because it exhibits high light transparencies (seiche disk) oftentimes in excess of 3 meters while other

impoundments in the area have transparencies that rarely exceed 0.5 meters. Measurements of light (as PAR) show that light penetrates through the entire basin to depths of 6-7 meters. Summer hypolimnion temperatures approximate the winter temperatures in the basin and anoxia occurs in the lowest reaches of the basin in late summer. The basin appears to turnover only in autumn when the summer thermocline is finally disrupted in late October. The establishment of the thermocline appears to be a gradual process that occurs during the late summer months. An annual vertical profile of the physico-chemical characteristics of this unusual Louisiana impoundment has been established.

- 37 KELLEY, RANDALL AND JEFF JACK. Department of Biology, Western Kentucky University, Bowling Green, KY 42101- Temporal variation in water chemistry parameters in a karst wetland

Chaney Lake is a seasonally flooded forested wetland located in Warren County, Kentucky. It fills and empties via fissures in the limestone bedrock that connect the lake to a subsurface cave system. The lake contains several distinct sub-habitats and we initiated a water quality monitoring program to determine if water chemistry parameters were different in the different areas. Samples were taken in each sub-habitat at least twice monthly from early January through August 5th (when the wetland completely dried) following USEPA methods. Temperature, pH, dissolved oxygen, conductivity and turbidity were taken using a YSI probe; ammonia, nitrates and orthophosphorus levels were determined analytically in the laboratory. Nutrient concentrations tended to be highest in isolated pools with little plant growth, and lowest at sample sites with high densities of aquatic plants. Dissolved oxygen levels tended to show the opposite trend. pH levels tended to be highest in areas with high amounts of canopy cover. Water chemistry data such as this will be important in interpreting the results of invertebrate surveys in different habitats at Chaney Lake.

- 38 JIN, EUN-JUNG AND GISELLE THIBAudeau. Mississippi State University - Signal transduction events involved in the pigmentation of the embryonic Zebrafish

Pigment cell precursors of the Zebrafish give rise to melanophores, xanthophores or iridophores. Cell signaling mechanisms related to the development of pigmentation remain obscure. In order to examine the mechanisms involved in pigment cell signaling, we treated Zebrafish embryos with various activators and inhibitors of signaling pathways. Among those chemicals tested, PMA, LiCl and LiCl/forskolin had stimulating effects on pigmentation, most notable in the melanophores. Results with the combined treatment of LiCl and forskolin were more dramatic than LiCl alone. We propose that the IP pathway, which is stimulated by LiCl, is involved in pigment pattern formation in Zebrafish through its involvement in the (1) differentiation/proliferation of melanophores, (2) dispersion of melanosomes, and/or (3) synthesis/deposition of melanin. To discern what level of pigmentation was being effected we (1) counted the number of melanophores in control and experimental animals 5 days after treatment, and (2) employed immunoblotting techniques with anti-TRP-2 and anti-MSG-1 as melanophore specific markers. Melanophore number decreased in LiCl- and forskolin-treated embryos but was not altered in LiCl/forskolin-treated embryos. The effect on pigmentation therefore was not through an increase in the differentiation of melanophores. Western blot analysis demonstrated an increase in MSG-1 and TRP-2 expression in LiCl-treated embryos and more significantly in LiCl/forskolin-treated embryos. These results suggest that involvement of the IP pathway in the stimulation of pigmentation is through dispersion of melanosomes or, more likely, the synthesis/deposition of melanin within the melanophores.

- 39 COGGIN, STEVEN J. Department of Biology, Catawba College, Salisbury, NC 28144 - Dynamic complexity in *Physarum polycephalum* shuttle streaming.

The plasmodial stage of the slime mold *Physarum polycephalum* exhibits a unique form of cell movement called shuttle streaming. This cell motility is characterized by rapid cytoplasmic flow and reversal of streaming direction at irregular intervals. The oscillator controlling reversal of streaming direction is not well characterized. To examine the possibility of complex dynamics in shuttle streaming the time between streaming reversals was measured over several hours. The time series of streaming reversal has a 1/f power spectrum typical of a self-organized system. Complex dynamics in *Physarum* streaming is probably due to interaction between components of the cell motility system. To test this hypothesis the effects of the F-actin disrupting drugs cytochalasin B and latrunculin B, and the Ca⁺⁺-ATPase inhibitor thapsagargin on shuttle streaming were

determined. The dynamics of shuttle streaming in the presence of the inhibitors was analyzed by constructing a phase space attractor and determining the attractor's correlation dimension. Cytochalasin B and thapsigargin do not abolish streaming in the plasmodium of *Physarum*, but the dynamics of streaming are altered so that the time between reversals is much shorter. Latrunculin B completely inhibits cytoplasmic streaming. The inhibitors alter the interactions between molecules involved in shuttle streaming and this is reflected in the change in dynamics.

- 40 CHELSIA L. VARNER, E.J. DAVIS AND SU-SHU PAN. Bowie State University and Division of Developmental Therapeutics, Greenebaum Cancer Center, Baltimore, MD 21201 -Molecular cloning of the Ku-70 and Ku-86 subunits of DNA Helicase II from human cells

DNA helicases are enzymes that separate DNA strands during replication, repair, and transcription. The human DNA helicase II is a heterodimer of 70 and 86 kDa polypeptides. Earlier report (Tuteja et al., 1994) has shown that this enzyme is identical to Ku, an autoantigen recognized by the sera of scleroderma and lupus erythematosus patients. Blockage of helicases by many antitumor agents is proposed to be one of the mechanism of drug action. The goals of this study are to clone the Ku-70 and Ku-86 subunits from human tumor cells, express the clones in *E. coli* for protein isolation, and study the properties of these proteins. HeLa S3 cells were initially used to generate a cDNA library from mRNA by reverse-transcription. Using two primers designed according to the cDNA of Ku-70 reported earlier (Reeves et al., 1988), a 2000 base pair (bp) region of Ku-70 was amplified by Polymerase Chain Reaction (PCR). However, the results obtained from HeLa S3 were negative. cDNA libraries of 6 other human tumor cell lines were then screened. Only human colon cancer HCT-116 cells generated the 2000 bp region of Ku-70. The PCR product was directly ligated into a pCR2.1 cloning vector. The ligated material was transformed into Topo-10 cells. Several clones were selected for plasmid isolation and the plasmids were verified by digestion with 2 restriction enzymes, Nde I, Bam HI. Four clones with the proper insert are currently being sequenced and one of the clones will be expressed in *E. coli* for protein isolation. (Supported in part by USPHS training grant ES07299-03)

- 41 KUPFER, HOLLY AND DWAYNE WISE. Mississippi State University - Nonrandom segregation of the sex univalents in the flea beetle, *Alagoasa bicolor*.

In the flea beetle, *Alagoasa bicolor* L., the males have two nonhomologous, achiasmate sex chromosomes (X and Y) that consistently segregate to opposite spindle poles even though they are not physically connected to each other. We have investigated the mechanism of this nonrandom segregation by time-lapse video, micromanipulation, confocal microscopy and immunofluorescence microscopy. We have confirmed the presence of two spindles, one for the autosomes and one for the sex chromosomes. The sex univalents begin prometaphase I in the amphitelic orientation (sister kinetochores attached to opposite poles). Before autosomal anaphase I, this orientation changes so that each sex chromosome becomes syntelically oriented (sister kinetochores attached to the same pole). Confocal microscopy indicates that, when sex chromosomes are amphitelicly oriented, the kinetochore fiber toward the near pole contains more microtubules than does the sister fiber. We are investigating the role of tension in the change in sex chromosome orientation. We propose a model to explain nonrandom segregation in these cells.

- 42 LEWIS, BRADLEY R¹., K. JACK KILLGORE², AND JAN JEFFREY HOOVER². ¹DynTel Corporation and ²U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS -Chronology of larval fish abundance in the floodplain of a regulated river system.

A two-year study is being conducted to evaluate the feasibility of hydroperiod management in a riverine floodplain of the Cypress Bayou System in Northeast Texas. The goal is to manage onset, rate, and duration of flooding that benefits aquatic species using prescribed releases from a flood control reservoir. Larval fish are being collected with light traps and ichthyoplankton nets in river and floodplain during the reproductive season. In 1997, floodplain inundation was minimized to the extent possible and represented normal operations. Spawning occurred from March-July, but peak larval fish abundance was in April when water temperatures ranged from 14-17°C. There was evidence that a rapid drop in water surface elevation in the floodplain stranded fish in isolated pools. In 1998, we will attempt to maintain peak discharges for the maximum period possible followed by a slow rate of decrease to minimize stranding and maximize rearing opportunities. Managing hydroperiod of a riverine floodplain, using controlled releases from flood control reservoirs, will demonstrate the opportunity to modify the "rule curve", or operational guidelines on water level management, to enhance fish reproduction under varying hydrologic regimes.

- 43 ANDERSON, ALLISON A. Dept. Wildlife and Fisheries Sci., Texas A&M Univ., College Station TX 77843-2258 - Reproductive and population differences between tailwater and non-tailwater orangethroat darters in central Texas

The orangethroat darter, *Etheostoma spectabile*, is a small riffle-dwelling fish native to the east-central U.S. including the Edwards Plateau in Texas. River impoundments in this area usually have cold, stable thermal environments for tailwater fishes. Previous laboratory work has shown that such thermal attributes can be favorable for spawning and larval development in this species. Below Lake Georgetown, Texas, these darters have higher density than in a nearby unimpounded fork of the San Gabriel River. To address whether between-population variation in life history attributes could account for the difference in density, I compared batch fecundity, mean egg diameter, and gonadosomatic indices (GSI) of the populations. Females of the non-tailwater population were only mature within a relatively narrow timeframe during the winter, whereas mature females in the tailwater could be found from late fall to early spring. Batch fecundity was higher in the tailwater population; however, mean standard length (SL) was also greater. The residuals from the regression of batch fecundity against SL showed no difference between the populations. Also, there was no significant difference between the populations for egg diameter or GSI. Although relative fecundity was the same for both populations, total fecundity was much higher for tailwater darters, resulting from a longer spawning season and larger mean SL. Abiotic factors, particularly water temperature and available riffle habitat, interact with the species' life history to determine population size.

- 44 BACKER, JENNIFER AND MARK SCHORR. Dept. of Biological and Environmental Sciences, University of Tennessee at Chattanooga, Chattanooga, TN 37403 -Abundance and structure of centrarchid assemblages in backwater and main channel border habitats of Nickajack Reservoir, Tennessee.

In most southeastern reservoirs, centrarchid assemblages are comprised of several fish species that support recreational fisheries. Backwater areas of reservoirs are utilized by centrarchids and other fishes, particularly during critical life history stages. Our study was designed to compare relative abundances of sunfishes *Lepomis* spp., black basses *Micropterus* spp., and crappies *Pomoxis* spp. in backwater areas and in adjacent channel border areas in the riverine section of Nickajack Reservoir, Tennessee. Fish were collected using two seining techniques (independent surveys) at 3-5 locations (randomly selected) within three backwater areas (>25 ha) and three channel border areas during four 6-week sampling periods, April-September 1995. Centrarchids comprised 49% of the total catch (N = 5,933 individuals): sunfishes, 43%; black basses, 4%; and crappies, 2%. Kruskal-Wallis tests indicated that sunfish and total centrarchid abundances (number/seine haul) were greater ($P < 0.10$) in backwater versus channel border areas, regardless of the sampling method. These findings indicate that riverine backwaters in Nickajack Reservoir support relatively large numbers of centrarchids (mostly sunfishes) during the spring-summer period of growth and reproduction. Anthropogenic activities that alter reservoir backwaters (lake level fluctuation, watershed development) could have pronounced effects on centrarchids and the fisheries that they support.

- 45 ENSIGN, WILLIAM E¹. AND PAUL L. ANGERMEIER². ¹Dept. of Biological and Physical Sciences, Kennesaw State University, Kennesaw, GA 30144 and ²Virginia Fish and Wildlife Cooperative Research Unit, Dept. of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061-0321 - Factors influencing stream fish recovery following a large-scale disturbance.

We examined fish distribution and abundance in erosional habitat units in South Fork Roanoke River, Virginia following a fish kill using a reach-wide sampling approach for 3 species and a representative reach sampling approach for 10 species. Qualitative (presence/absence) and quantitative (relative abundance) estimates of distribution and abundance provided consistent measures of fish recovery for 2 of 3 species at the reach-wide scale and 8 of 10 species at the representative reach scale. Combining results across scales and estimator types showed that distribution and abundance of 5 of 11 species in the reach affected by the kill was similar to that observed in unaffected upstream and downstream reaches 8 to 11 months following the perturbation. Differences in distribution and abundance between the affected and unaffected reaches indicate that 4 of 11 species had not fully recovered during the same time period, while the results were equivocal for 2 other species. We attribute differences in recovery rates between these two groups to differences in parental investment in offspring. Species exhibiting rapid recovery either engage in extensive spawning site preparation or guarded the spawning site following egg deposition and fertilization. Species that had not recovered in the year following the kill show limited spawning site preparation and do not guard the spawning site.

- 46 SMEE, DELBERT L., JONATHAN COPELAND, and DANIEL V. HAGAN. Dept. of Biology, Georgia Southern University, Statesboro, GA - Behavior of Nantucket pine tip moths and *Hyssopus rhyacioniae*, its primary parasitoid in the Coastal Plain of Georgia.

Nantucket pine tip moths, *Rhyacionia frustrana* (Lepidoptera: Tortricidae), are common pests of loblolly pines in the southeastern United States. Larvae of this moth feed on the shoots of young pines. This feeding stunts tree growth, damages tree shape, and may cause tree death. Like many other lepidopterans, larvae of this moth are vulnerable to a variety of dipteran and hymenopteran parasites, *Hyssopus rhyacioniae* (Hymenoptera: Eulophidae) is the most abundant. The purpose of this study was to study the olfactory basis of choice of the Nantucket pine tip moth and its most common parasitoid. A Y-type airflow olfactometer was used to observe behavior of both *R. frustrana* and *H. rhyacioniae* when exposed to various chemical compounds. Insects walk upwind in the olfactometer, until reaching a choice zone. In the choice zone, the insects were given a two-odor paradigm and permitted to choose one of the odors. Control tests were conducted in which clean air was used as both choices. Experimental tests consisted of clean air as one odor choice and another odor source as the second choice. Most (90%) Nantucket pine tip moths chose loblolly pine over other odors. Loblolly pine was found to be the most attractive odor to *H. rhyacioniae* with 93% choosing it over other odors.

- 47 WALLACE, MONICA AND RICHARD BUCHHOLZ. Department of Biology, Northeast Louisiana University, Monroe, LA 71209-0520 - Cross-fostering of red-cockaded woodpecker nestlings: preliminary results.

Red-cockaded woodpeckers (*Picoides borealis*) are endangered because of deforestation, forest fragmentation, and modern forest management practices. Small isolated populations of this species probably experience very little gene flow, and thus may be additionally threatened by the deleterious effects of inbreeding. Translocation of adult woodpeckers has met with only limited success, largely because translocated individuals have a high probability of dispersal. In 1997 we began developing field techniques for transferring nestling red-cockaded woodpeckers between populations on public and private land in northeast Louisiana and south central Arkansas. Eight nests that met specific criteria were used in the experiment. Eighty-eight percent of cross-fostered nestlings survived to fledging. In control nests 78% of nestlings fledged successfully. These preliminary results suggest that cross-fostering of nestlings, under certain conditions, can be an effective way to introduce allelic diversity to small, isolated populations of philopatric bird species. In our continuing study we will attempt additional nestling translocations, monitor parental care by foster parents, and examine the genetic diversity of endangered woodpeckers in this region.

- 48 CORLEY, J. BRIAN. Biology Department, North Georgia College and State University, Dahlonega, GA 30533 - Reintroduction history and observations of a mated pair of Southern Bald Eagles (*Haliaeetus leucocephalus leucocephalus*) and their fledged young of the year.

A five month, observational study of a mated pair of the Southern Bald Eagles was conducted from June through October, 1997. The subjects of the study included both parent eagles and their young of the year. The research objectives were to observe the progress of the reintroduction program, adult and fledgling behavior, and the birds' adaptability to both the natural habitat and to human disruption. Observations on diet and feeding habits were recorded, and territorial disputes were observed with several of the families of nesting osprey on the lake. Rearing behavior was observed as well as behavior of the fledged eaglets as they developed, and behavioral patterns of all four birds. The eagle's dietary staple consisted of channel catfish. Eagle-osprey combat was observed. Even though bald eagles are classified as migratory birds by The Migratory Bird Act, the eagles at Lake Oconee remained in the area over the course of the entire year. Extensive observations of fledgling conditioning behavior and parent-fledgling and fledgling-fledgling interactions were recorded.

- 49 HULSEY, BANNIE C.¹, DANIEL V. HAGAN¹ and C. WAYNE BERISFORD². ¹Dept. of Biology, Georgia Southern University, Statesboro, GA 30460 and ²Dept. of Entomology, University of Georgia, Athens, GA 30602. - Edge effects and their influence on distribution of Nantucket pine tip moths and their parasitoids.

Nantucket pine tip moths, *Rhyacionia frustrana* (Comstock), are common pests of loblolly pines (*Pinus taeda*) in the southeastern United States. Pine tip moth damage causes deformation and/or retardation of tree growth;

however, in extreme cases of heavy infestation, tree death can occur. The study site, 20 miles E of Statesboro in Bulloch County, GA, consisted of four pine stands of varying ages (2 - 3 years) and silvicultural treatments (normal and intensive). To determine if an edge effect influenced *R. frustrana* and parasitoid distribution, 15 trees were surveyed twice each month (June to November 1997) from the plots in three locations: woodland edge, road edge and interior (10-15 m from edge of plot). More tip moths were found in the woodland and road edge locations than the interior. Twelve species of parasitoids were identified with *Lixophaga mediocris*, *Hyssopus rhyacioniae* and *Eurytoma pini* being the most abundant.

- 50 TENNANT-CLEGG, ESTHER P. AND JERALD D. HENDRIX. Kennesaw State University - Characterization of bacteria responsible for background anomalies in the quantitation of fecal coliform bacteria by the membrane filter technique.

The concentration of fecal coliform bacteria is used as an index of water quality in aquatic systems. We have identified bacteria that cause background interference in the membrane filter technique of counting fecal coliforms. Fecal coliform bacteria produce blue-colored colonies on mFC agar, due to a drop in pH caused by the acid fermentation of lactose. We observed that about 10% of water samples from a stream contained bacteria that produced yellow colonies on mFC agar and that the presence of these bacteria inhibited the blue color of fecal coliform colonies. We characterized sixteen isolates from a water sample, including both typical and atypical colonies. Bacteria that exhibited atypical colonies were classed into two groups: lactose-nonfermenting *Escherichia* (*Escherichia fergusonii*) and nonfermentative gram-negative species, including species of *Pseudomonas*, *Acinetobacter*, and *Bordetella*. We established that the atypical color development was due to an increase in pH. During typical blue colony development, the pH dropped from 7.4 to less than 5.0. However, the presence of atypical colonies caused the pH to rise from 7.4 to above 8.0. We believe that the increase in pH is due to alkaline metabolic waste products excreted by bacteria growing with an oxidative metabolism.

- 51 SPRATT, HENRY G., JR., and MICHAEL G. WEATHERSBY. University of Tennessee at Chattanooga, TN 37403 - Sulfur transformations in surface soils of the Tennessee River Gorge.

Transformations of S were determined for A- and B-horizon soils collected from 4 permanent plots located in the Tennessee River Gorge (TRG), just down stream from Chattanooga, TN, during summer and fall 1997. The TRG is relatively undisturbed, and includes habitats for several endangered species. This study focuses on sulfur transformations in TRG surface soils to determine baseline conditions of soil sulfur, which will later be important to understanding overall soil nutrient status. Incorporation of sulfate into soil organic sulfur (OS) by microorganisms was monitored using established ³⁵S methodology. Sulfur pools quantified included: total sulfur (TS), water soluble SO₄²⁻ (WS), adsorbed SO₄²⁻ (ADS), and OS (determined by difference). TS was determined using an elemental analyzer (total C was also determined), while WS and ADS were extracted and quantified by ion chromatography. Microbial OS production was seasonal, with max. rates occurring in the summer. TS was 2 to 5 times greater in A-horizon soils than in B-horizon soils (A-horizon soil TS ranged from 11 ± 2 to 32 ± 6 μmol/g, while B-horizon TS ranged from 5.0 ± 0.4 to 9.0 ± 1.7 μmol/g). Soils from north-facing slopes had considerably higher TS than were found in soils from south-facing sites. Total C also was found to be higher in A-horizon soils from north-facing slopes than in soils from south-facing sites (21 ± 3 vs. 7 ± 1 mmol C/g), suggesting that soil temperature and moisture play a role in regulating surface soil C and S transformations. Future studies of these plots will include determinations of nutrient cation status of the soils, and quantification of OS mineralization to determine any relationships between soil OS and the presence of exchangeable bases. This work has been supported by a grant from the University of Chattanooga Foundation.

- 52 BERGIN, JARON J.¹, HENRY G. SPRATT Jr.¹, AND DOUG FRITZ². ¹The University of Tennessee at Chattanooga and ²City of Chattanooga, Stormwater Division - Monitoring fecal coliform in stormwater discharge in order to identify nonpoint source pollution.

Fecal coliform contamination of stormwater was monitored in samples collected within the city of Chattanooga, TN under high and low flow conditions beginning in November 1997. Samples were transported to a laboratory and membrane filtered within 6 hours of collection in accordance with published methodology. After 24 hour incubations at 44.5 ± 0.2 °C, statistically valid counts were those which yielded 20-60 coliform colonies per plate (expressed as coliform colony forming units per 100 ml). Preliminary data was collected from 2 tributaries of Citico Creek before and after a significant rainfall. In addition, surface water from a wetland constructed to treat parking lot runoff on the UTC campus was also sampled before and after significant rainfall. In Citico Creek, fecal contamination varied greatly between tributaries, and also was affected by recent rainfall. At one Citico Creek location, a tributary had 3,200/100ml, while an adjacent branch had 570/100ml before a precipitation event. Approximately 1 cm of ppt. had little effect on the first tributary (3,200/100ml), but resulted in a large increase in contamination in the second tributary (a 5.8 fold increase to 3,300/100ml). At the second site on Citico Creek contamination was also found and responded similarly (780/100ml and 4,270/100ml before and greater

than 20,000/100ml in both tributaries after the ppt.). The wetland had much lower contamination (0/100ml before and 700/100ml after the ppt.). The monitoring of these sites and 95 more, based on land use parameters, will continue in order to identify nonpoint source pollution within the City of Chattanooga. This study is supported by a grant from the City of Chattanooga Stormwater Division.

- 33 SPRATT, HENRY G., Jr., and KRISTEN B. HOWERTON. The University of Tennessee at Chattanooga - Carbon and Sulfur transformations in A-horizon soils of the Missouri Ozark Forest Ecosystem Project One Year Post Harvest.

Transformations of C and S were determined for A-horizon soils collected from 12 permanent plots located in the Missouri Ozark Forest Ecosystem Project (MOFEP) in southeastern Missouri on 4 dates from May 1995 to May 1996, representing pre-treatment conditions. Post-treatment samples were collected on 4 dates beginning in December 1996. Treatments include: no timber harvest (4 plots), clear-cut timber harvest (4 plots), and selective timber harvest (4 plots). Mineralization of ^{14}C -lignocellulose (of *Quercus alba*) was used as a measure of microbial activity in the soils. Total C (TC) was determined by elemental analysis. S transformations determined included microbial production and mineralization of organic S (OS), using established ^{35}S methodology. S pools quantified included: total S (TS), water soluble SO_4^{2-} , adsorbed SO_4^{2-} , and OS (determined by difference). A-horizon soils from clear-cut sites initially had higher levels of TC and TS in March 1997, compared with soils collected on approximately the same date prior to cutting (67% increase in TC and a 92% increase in TS). This trend was not evident in soils from the selective cut sites. Later in May 1997, however, these trends in TC and TS changed. Clear-cut sites had only 74% of the TC and only 48% of the TS that was found in these soils one year before, prior to the cutting. In May 1997, two of the selective cut sites exhibited slight losses of both TC and TS (TC @ 74 %, and TS @ 66% of the pre-treatment values). Current analyses are focusing on microbial lignocellulose mineralization and OS production and mineralization. Future work will determine any relationships between changes in C and S components of the soil with regard to other nutrients present. This work has been supported by grants from the Missouri Department of Conservation.

- 54 SMITH, PETER AND GARY L. WALKER. Dept. of Biology, Appalachian State University, Boone, NC 28608 - A vegetational characterization of cliff face communities in the Linville Gorge Wilderness Area

Throughout North America few ecosystems have escaped disturbance associated with the rapid expansion of humans. Cliff face ecosystems are largely undisturbed and some represent ancient presettlement forests. However, even these habitats are now being disturbed by rock climbing and rappelling. There are two aspects to this study. The first is to compare cliff edge rock outcrop communities to cliff face communities. Rock outcrop communities have been extensively characterized while cliff face communities have been relatively poorly studied. The second aspect is to compare disturbed and undisturbed cliff edge and cliff face communities. Vertical line transects were used to measure percent cover of the floral and lichen taxa of cliff edge and face communities in randomly selected disturbed and undisturbed sites. Thus far, three taxa (*Cetraria* sp., *Rhizocarpon* sp., *Woodzia scopulina* var. *Appalachiana*) have been found only on cliff faces. Also, fire released taxa on cliff edges are absent from cliff face communities. *Rhododendron minus* and *Selaginella* sp. had higher percent cover on undisturbed cliff edges and faces; other taxa displayed no obvious pattern with respect to disturbance. These results may suggest ways in which these fragile habitats can be better managed using specific indicator species.

- 55 ROBERTSON, PHILIP A. AND MARK BASINGER. Southern Illinois University, Carbondale - Characteristics of Coarse Woody Debris in two old-growth forests in southern Illinois.

Coarse woody debris was sampled in an old-growth bottomland and an upland hardwood forest. Both forests had experienced windthrow in June of 1993 in addition to subsequent flooding in the bottomland and cutting in the upland forest. In the upland forest, decay classes I and II comprised 40% of the CWD while following cutting, these classes comprised 55%. Most of this increase was due to branches. Branch volume was 31 and 77% of the total in the pre-cut and post-cut stands, respectively. In the pre-cut upland forest, 52% of the CWD was in decay classes IV and V. In the bottomland forest, 46% of the CWD was in decay classes IV and V. Forty six % of the total CWD was due to windthrow while <1% was due to flooding. Most of this was in decay classes I and II. Sixty four percent of was from branches while 32% was from tree boles. Class IV had the largest component of CWD with $42 \text{ m}^3 \text{ ha}^{-1}$ (38%) followed by decay class I which had $33.5 \text{ m}^3 \text{ ha}^{-1}$ (30%). Average CWD was 112.0 and $65.4 \text{ m}^3 \text{ ha}^{-1}$ for Horseshoe Lake and the pre-cut Weaver's Woods, respectively. CWD in Weaver's Woods after cutting was $151.2 \text{ m}^3 \text{ ha}^{-1}$.

- 56 FLETCHER, TARA S. AND JOHN L. VANKAT. Dept. of Botany, Miami University, Oxford, OH 45056-Understanding old-growth forests of southcentral Alaska: herbaceous species.

There is no universal definition for the term "old growth" forest because old-growth properties are specific to location. Alaska has two well-known forest types, the Coastal and Interior forests. A third, poorly-studied type occurs in southcentral Alaska where climatic conditions are unique. Old-growth forests in this area are composed of only two species, white spruce (*Picea glauca*) and paper birch (*Betula papyrifera*). However, herbaceous species richness is much greater. Therefore, herbs may provide additional, if not greater, insight into these forests. During the summer of 1997, we utilized 18 20 x 25m study plots on Fort Richardson Army Base near Anchorage to determine whether some herbaceous species uniquely characterize old-growth forests of southcentral Alaska. The plots were located to encompass various landforms and stand age classes. Percent cover estimates were conducted on 1 x 1m subplots approximately every three weeks throughout the growing season. Findings indicate that the presence or absence of herbaceous species is consistent across forest ages. However, species abundances are variable and therefore aid in defining "old growth" for this region.

- 57 HITCHCOCK, STEPHANIE L.¹, A. JOSEPH POLLARD¹, AND KATHERINE J. ELLIOTT².
¹Furman University and ²US Forest Service, Coweeta Hydrologic Laboratory - Effects of catastrophic windthrow followed by salvage logging on herbaceous layer species in the southern Appalachians.

A natural disturbance such as catastrophic windthrow can play a major role in the structure of understory herbaceous layer species in forests. Winds from Hurricane Opal struck Coweeta basin on October 5, 1997. Following the hurricane, salvage logging was done to resemble a two-age shelterwood cut. This study evaluates regeneration and vegetation dynamics affected by catastrophic windthrow, comparing the hurricane + salvage logged areas to watershed 40, an adjacent watershed which was not hurricane damaged nor salvage logged. In order to compute species diversity, we computed the Shannon-Weiner index of diversity (H') and Pielou's evenness index (J'). A significant increase in diversity was found in the hurricane + salvage logged areas compared to the control. Early successional species such as *Aster* spp. and *Solidago* spp. did not overshadow the importance of the late successional species in the hurricane + salvage logged plots. Many late successional species were more dominant in the hurricane + salvage logged areas. For example, *Viola cucullata*, known as a late successional species had an importance value of 7.76 in the hurricane + salvage logged plots but was not even found in the late successional forest control plots. Our study shows increased density and percent cover after one growing season. Future studies will determine if the shade intolerant and shade tolerant species can coexist in this disturbed area through the stages of succession.

- 58 HORN, CHARLES N.¹, JONATHAN WILLIAMS², and C. CLINTON HARSHAW³. ¹Biology Department, Newberry College, ²Governor's School for Science and Mathematics and ³Mathematics & Computer Science Department, Newberry College. - A preliminary study of soils and vegetation on floodplains in the piedmont of South Carolina.

Sites on nine different streams within the piedmont of Newberry and Union Counties, South Carolina were investigated to determine the predictors of tree importance (IV) from among the soil characteristics of pH, organic content and texture. Sites were picked as typical locations formed as a result of extensive siltation from eroded uplands 50-100 years ago. Most important canopy trees include *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tulip poplar), and *Celtis laevigata* (hackberry). At each site, three randomly selected plots were selected where soil samples were collected from the surface, one meter and two meters depth. Multiple linear regression analysis was completed, controlling for site, by tree species, and assuming no interaction. The results showed that soil pH, percent silt, and organic matter content are significant models for predicting the importance values of some of the existing tree species.

- 59 ULREY, CHRISTOPHER J. AND THOMAS R. WENTWORTH. North Carolina State University - A comparison of Detrended Correspondence Analysis and Nonmetric Multidimensional Scaling using three Southern Appalachian datasets.

The relative effectiveness of two ordination procedures, Detrended Correspondence Analysis (DCA) and NonMetric Multidimensional Scaling (NMDS), was evaluated using data from three landscapes in the Southern Appalachians. The datasets used were chosen because they represent the range of conditions likely to occur in this region. The first dataset is from the Black and Craggy Mountains, a high elevation landscape that is relatively undisturbed. The second dataset is from the Thompson River, a low elevation landscape that

is highly disturbed. The third dataset, High Elevation Red Oak, contains information about a specific community that was collected from across the region. We used three types of data transformation with each ordination procedure. Evaluations were based on absolute differences (via procrustes analysis), degree of correlation with environmental variables, agreement with *a priori* classifications, and subjective interpretability. We found that NMDS consistently outperformed DCA, and we present empirical findings to support this conclusion.

- 60 MCLEOD, KENNETH W. AND JOHN E. PINDER, III. Savannah River Ecology Laboratory, University of Georgia - The relationships of multitemporal drought stress indicators from Thematic Mapper data to measured growth effects in longleaf pine plantations

A severe drought during 1990 resulted in visible stress to longleaf pine (*Pinus palustris* Miller) plantations on the U. S. Department of Energy's Savannah River Site in Aiken County, South Carolina. The relationships between drought stress indices derived from Thematic Mapper data and reductions in tree ring widths of longleaf pine were examined for 30 plantations on various soil types. Drought stress, measured as the ratio of reflectance in band 5 to band 4, was greater during the beginning of the summer (7 June 1990), after a period of intense heat (9 July 1990) and at the end of the summer (27 September 1990) than for periods preceding or following the drought. Tree ring widths during 1990 were significantly less than those observed in the years preceding the drought. Significantly smaller ring widths also occurred in 1992 and 1993, during years of normal precipitation, and suggested prolonged effects of the drought. Ring widths in 1991, a year of unusually large precipitation, were not smaller than those before the drought. The degree of ring width reduction was significantly correlated with the satellite derived measure of drought stress. The greater the ratio of band 5 to band 4 reflectance for a plantation, the greater the reduction in ring widths.

- 61 TUBERVILLE, TRACEY D. Savannah River Ecology Lab, University of Georgia - Effects of soil disturbance by gopher tortoises (*Gopherus polyphemus*) on vegetation in the longleaf pine - wiregrass ecosystem

Gopher tortoises, *Gopherus polyphemus*, are large terrestrial turtles that construct extensive underground burrows. Tortoises are considered a keystone species because their burrows provide habitat for many other species of animals. Few studies have explored other ecological roles they may serve in the longleaf pine - wiregrass ecosystem, such as their potential impact on herbaceous vegetation. This species may alter the habitat through small-scale disturbances at sites of burrow construction. In 1996, I began a two-year study of the effects of these disturbances on herbaceous vegetation. Species composition, richness and percent cover were evaluated in spring and late summer in 1996 and 1997 at 15 active burrows, 15 abandoned burrows, and 15 randomly selected undisturbed control locations. In addition, 15 randomly-placed mimic burrows were constructed and surveyed in order to determine if any differences detected between active burrows and control locations could be attributed solely to disturbance. Effects of small scale disturbances by gopher tortoises on vegetation, as determined in this study, will be discussed in the context of their importance to the ecology of longleaf pine - wiregrass ecosystem.

- 62 BOOTH, ROBERT K. AND FREDRICK J. RICH. Georgia Southern University - Holocene vegetation history and paleoecology of Beach Pond, St. Catherines Island, Georgia

Beach Pond is a fresh water pond, or marsh, located approximately 50-100m from the beach scarp in the mid-southern portion of St. Catherines Island, Liberty County, Georgia (31°37'N latitude, 81°09'W longitude). A 4.5 meter sediment core was obtained from the pond in an effort to reconstruct the paleoecology of the site. The sediments are all Holocene in age (<4000 years); they consist of sand, clay, and peat. The modern vegetation of Beach Pond is dominated by *Pluchea* and other composites, *Teucrium*, *Typha*, Cyperaceae, and Poaceae. The palynology of the core reveals dynamic changes in the depositional environments and plant communities during sediment accumulation. Sediments from the lower portion of the core were derived from near shore marine environments; these are characterized by the abundant pollen of *Pinus* and members of the Chenopodiaceae or Amaranthaceae. Tidal flat sediments are then overlain by a thin peat layer derived from an interdunal swale community dominated by *Myrica*. A return to brackish marsh conditions then occurred, as indicated by the presence of *Limonium*, Cheno-Am type (i.e. *Salicornia*, *Batis*), and abundant Poaceae pollen. The modern fresh water pond plant community became established as the salinity decreased; this is indicated by the abundance of fresh water plant taxa (i.e. *Azolla*, *Typha*, Cyperaceae). Sea level fluctuation, erosion, storm overwash, and anthropogenic factors (i.e. road building, water well drilling) have all influenced the development of past and modern plant communities by altering the hydrology and salinity of the site.

- 63 BASINGER, MARK A. AND PHILIP A. ROBERTSON. Southern Illinois University, Carbondale - Woody vegetation change following timber harvest in the Ozark Hills of southern Illinois.

Woody vegetation at Weaver's Woods was sampled in 1994-95 and 1997 in 29 0.25 ha permanent plots to determine change after timber harvest. Tree (> 6.6 cm dbh) basal area was $31.0 \text{ m}^2/\text{ha}$, density was 425.8 stems/ha, and species richness was 12.5 taxa/plot before timbering. Shrub (> 2.54 cm < 6.6 cm dbh) density was 565.2 stems/ha, while seedling (< 2.54 cm dbh) density was 115,487.0 stems/ha. *Acer saccharum*, *Carya ovata*, and *Quercus alba* were dominant tree species. *A. saccharum* and *Asimina triloba* were dominant shrubs, and *Toxicodendron radicans*, *Parthenocissus quinquefolia*, and *Ulmus* spp. were dominant seedlings. Tree basal area ($12.9 \text{ m}^2/\text{ha}$), density (230.1 stems/ha), and species richness (9.0 taxa/plot) decreased following timber harvest. Shrub density also decreased to 211.3 stems/ha, while seedling density decreased to 108,265.7 stems/ha. The same tree and shrub species were dominant after timber harvest, while the seedling stratum was dominated by many taxa, especially early successional woody species such as *Liriodendron tulipifera*, *Celtis* spp., *Morus rubra*, *Rubus* spp., *Sassafras albidum*, and *Prunus serotina*. Since mesophytic species were not decreased in importance in Weaver's Woods while oak-hickory species were, it appears that a conversion to a maple-beech forest is inevitable.

- 64 PHELPS, TIMOTHY R., JAMES S. FRALISH, AND DANIEL R. UNGER. Department of Forestry, Southern Illinois University at Carbondale - Comparison of presettlement and present vegetation cover of Marion County, IL using a geographic information system.

Original land survey records from 1818 - 1820 were used to reconstruct presettlement vegetation across Marion County, Illinois. Marion County is located in the prairie - forest transition zone between the forested Shawnee Hills to the south and the prairie peninsula to the north; witness tree data for several counties in each region have been analyzed. Witness tree data were taken from section and quarter-section points along each of 16 townships. Tree species, diameter, distance, and direction from each section and quarter section were recorded. Bray-Curtis point quarter method was used to establish a relative density at each point. Forest, savannah, and prairie cover types were distinguished based on relative density. Soil associations and their respective distribution in the landscape were obtained from recent soil survey records and compared with relative density to expand vegetation cover from point coverage to area coverage. These data were analyzed using a geographic information system (ArcInfo). Present vegetative cover was reported from the Illinois Department of Natural Resources Critical Trends Assessment Program and overlain with the presettlement coverage to determine the loss of natural vegetation over a period of about 175 years. Additional ecological relationships were identified between presettlement community types and slope position.

- 65 ADAMS, ERIC D.¹, DAVID J. GIBSON¹, JOSEPH S. ELY¹, DANNY J. GUSTAFSON¹, DOUGLAS N. McEWEN², AND TRACY EVANS³. ¹Dept. of Plant Biology and ²Dept. of Health Education & Recreation, Southern Illinois University at Carbondale, Carbondale, IL 62901 and ³Illinois Department of Natural Resources, Belnap, IL 62908 - Vegetation recovery over an 18 year period at a recreational facility.

A study investigating the effects of the removal of recreational impacts on the natural environment at Ferné Clyffe State Park, Illinois was initiated in 1979. Prior to 1979, the site was a recreational facility used as a picnic and camping area. Seventeen 1 m^2 permanent plots were established to observe the change in vegetation cover and composition of the herbaceous layer after the facility was removed. Plots were sampled in 1979, 1981, 1988 and most recently in 1997. Species richness and the number of abundant species showed significant ($p < 0.05$) increases over time. Initial species composition showed weed species such as *Poa annua* and *Festuca pratensis* with high frequencies and cover values. The most recent sampling dates indicate that a shift in species composition has occurred from an abundance of weedy species to species more characteristic of rich woodlands such as *Carex jamesii* and *Muhlenbergia sylvatica*. Detrended Correspondence Analysis (DCA) was used to examine trends in overall species composition. Results indicate that after 18 years the herbaceous layer of the recreation area now appears to be comparable with surrounding secondary forest areas in the State Park.

- 66 SHUMWAY, DURLAND L., JOSEPH K. SCHNATTERLY, STEPHEN A. DINKELACKER, AND MARGARET T. PANTALL. Frostburg State University - Spatial distribution of oak species in pre-settlement forest stands in Western Maryland.

Patterns in spatial distribution of *Quercus*-dominated forests were studied in several pre-settlement stands in Western Maryland. These stands were characterized by high

canopy-tree species richness and the presence of multiple cohorts of oaks. Fire history, stand maps, and dendroecological data were collected along elevational gradients to evaluate the correspondence between the occurrence of fires and the establishment of multiple oak cohorts. The importance of fire frequency and the potential for different dispersal mechanisms among oak species were considered as potential determinants of oak dominance and distribution.

- 67 WINSTEAD, JOE E. Dept. of Biological and Environmental Sciences, Morehead State University, Morehead, KY 40351 - Pattern of recovery thirty-two years after clear cutting of a hemlock forest in eastern Kentucky.

Dominated by *Tsuga canadensis* when clear cut in 1965, a south-east facing slope in Laurel County, Kentucky, within the Daniel Boone National Forest, has shown recovery from a combination of seedling growth and stump sprouts to a basal area of 12.75 m²ha⁻¹ consisting primarily of yellow poplar, red maple and black oak. Approximately 35% of the basal area has resulted from stump sprouts, primarily of yellow poplar and red maple, which have contributed 20% of the density of 350 trees ha⁻¹. Shortleaf pine development currently makes up 11.6% of the basal area and approximately 15% of the tree density indicating the dryer aspect of the area following the removal of all the canopy trees. During the first 20 years of recovery seedlings of dogwood and red maple appeared dominant but the sapling age class now consists of almost equal numbers of oaks and hickories which combined with the dogwoods and red maples make up almost 48% of the estimated 3822 saplings ha⁻¹.

- 68 COLLINS, B. AND G. WEIN. Savannah River Ecology Laboratory - Disturbance frequency and intensity effects on early oldfield succession.

In dynamic grasslands and oldfields, early successional species may persist longer with disturbance. The intermediate disturbance hypothesis (IDH) predicts that species richness over a field and through time should be greatest with moderate disturbance frequency and/or intensity. Clipping frequency (none, 2x per yr, 1x per yr, 1x per 2 yr, 1x per 4 yr) and intensity (- all, - dominant) were varied to test the IDH and evaluate disturbance effects on oldfield dynamics during the first 6 yr of succession. By year 6, there was a gradient of species richness from the most rich plots with all vegetation removed 1x or 2x per year, through plots with dominants removed 1x or 2x per year, to the least rich plots that were disturbed 1x per 2 or 4 yr or were left undisturbed. Early successional species persisted in plots with all vegetation removed $\geq 1x$ per 2 yr. These results do not agree with the IDH; rather, they suggest a disturbance intensity/frequency threshold beyond which early successional species persist and later successional species fail to establish or do not become dominant.

- 69 BASINGER, MARK A.¹ AND JODY P. SHIMP². ¹Southern Illinois University, Carbondale and ²Illinois Department of Natural Resources, Dixon Springs - Status of *Silene ovata* Pursh in Illinois.

Silene ovata Pursh is an herbaceous, perennial member of the Caryophyllaceae found locally in rich mesic forests throughout the southeastern United States. This plant was recently discovered in Hardin County, Illinois in 1995, is known from 6 small populations, and has been listed as State Endangered by the Illinois Species Protection Board. A status report is being written for *Silene ovata* in Illinois to document all known populations and determine habitat and environmental characteristics. *Silene ovata* occurs on calcareous sandstone boulders and soil in dry-mesic and mesic hardwood forests along the Ohio River near the interface of the Greater and Lesser Shawnee Hills Sections of the Shawnee Hills Physiographic Division. Common plant associates include *Aquilegia canadensis*, *Hydrangea arborescens*, *Phacelia bipinnatifida*, *Polymnia canadensis*, *Saxifraga virginensis*, *Solidago caesia*, *Solidago sphacelata*, and *Tradescantia subaspera*. *Silene ovata* flowers in Illinois from mid-September to early-October and appears to be another member of the Appalachian flora that reaches its western range limit in southern Illinois.

- 70 RISK, ALLEN C. AND JACK R. OUSLEY II. Department of Biological and Environmental Sciences, Morehead State University, Morehead, KY 40351 - Preliminary bryophyte and vascular flora of the Hog Hollow Seeps, Bath County, KY.

The Hog Hollow Seeps comprise seventy streamhead swamps located near Cave Run Lake Dam in the Daniel Boone National Forest. These wetlands occur at the contact between Quaternary fluvial deposits and Mississippian shales and siltstones. The sites range in area from 5 m² to over 1000 m². The most abundant woody plants in these wetlands are *Acer rubrum*, *Nyssa sylvatica*, *Alnus serrulata*,

Ilex verticillata, *Lindera benzoin*, and *Aronia melanocarpa*. The ground layer is dominated by *Carex atlantica* subsp. *atlantica*, *Carex seorsa*, *C. lurida*, *C. crinita*, *C. debilis*, *Osmunda cinnamomea*, *O. regalis*, and *Glyceria striata*. Bryophytes are abundant at the sites with *Thuidium delicatulum*, *Pallavicinia lyellii*, *Odontoschisma*, *Plagiomnium ciliare*, and *Sphagnum lescurei* being the most common taxa. New state records found during the ongoing study are *Telaranea nematodes*, *Pleuridium palustre*, *Aneura maxima*, and *Carex seorsa*. Other uncommon taxa include *Sphagnum magellanicum*, *Eriophorum virginicum*, and *Xyris difformis*. At two of the sites, a putative *Carex* hybrid (*C. seorsa* X *C. atlantica* subsp. *atlantica*) was discovered. The presence of aborted achenes, nonexserted stamens, and morphological intermediacy of the perigynium beak between that of *C. seorsa* and *C. atlantica* subsp. *atlantica* support the hybrid interpretation of the latter specimens.

- 71 RAMSEY, GWYN W. Herbarium (LYN), Lynchburg College, Lynchburg, VA 24501 - PLANT DIVERSITY SURVEY OF THE PEAKS OF OTTER BACKCOUNTRY AREA, BLUE RIDGE PARKWAY, VIRGINIA.

A three year study reveals that the vascular flora of the Peaks of Otter, in the Blue Ridge Mountains of central Virginia (Blue Ridge Parkway Mile Post 83.5 - 87.5), is interestingly diverse. Voucher specimens document a vascular flora of 357 genera in 97 plant families with 662 species within the 2500 hectare research area. Largest collections of the Peaks of Otter Flora are represented by the Asteraceae (77 spp.), Poaceae (48 spp.), Rosaceae (36 spp.), Cyperaceae (29 spp.), Liliaceae (29 spp.), Fabaceae (29 spp.) and Lamiaceae (25 spp.). Of the species collected, 121 (18%) are introduced. Eight federally and/or state listed rare taxa were discovered and mapped during the study and eight potential habitats were described and mapped. Kodachrome slides and a videotape help document the study. (Supported by Department of Interior, National Park Service, Blue Ridge Parkway, Cooperative Agreement, #CA 5140-1-9002, SUB A #1).

- 72 FLAGG, RAYMOND O., GERALD L. SMITH, AND WALTER S. FLORY. Carolina Biological Supply Company, High Point University, and Wake Forest University - Floral morphometric separation of southeastern species of *Zephyranthes*.

Three closely related species of *Zephyranthes* are native to the southeastern US: *Z. atamasco* (type species for the genus), *Z. treatiae* and *Z. simpsonii*. Although the specific status of *Z. treatiae* has been questioned, all three species are readily distinguishable by leaf and floral morphology. In herbarium specimens, leaf differences may not be clear, but morphometric methods show decided floral distinctions. The species are separated by comparing the length of the perianth tube to the lengths of other floral elements: perianth, filaments, and style. The perianth tube length is less than 1/4 of the total perianth length in *Z. atamasco*, 1/4 or more in *Z. treatiae*, and 1/3 or more in *Z. simpsonii*. The filament length is usually at least 2 times the length of the perianth tube in *Z. atamasco*, usually less than 1.5 times in *Z. treatiae*, and about 1 times in *Z. simpsonii*. The style length is usually at least 3.5 times the perianth tube length in *Z. atamasco*, about 3 times in *Z. treatiae*, and less than 2.5 times in *Z. simpsonii*. A scatter diagram using such ratios of the floral parts from an extensive sampling of southeastern US herbarium specimens shows three distinct taxa.

- 73 HYATT, PHILIP E. Kisatchie National Forest, Shreveport, LA 71360 - Arkansas *Carex* (Cyperaceae): a briefly annotated list.

Recent collections and herbarium specimen study resulted in this review of the status of the 121 taxa in the genus *Carex* occurring in the state of Arkansas, USA. A list of these taxa provides frequency and habitat data, while county dot maps show known distribution. The list gives additional information on selected taxa, especially on rare species, on taxa previously considered rare in Arkansas, or on nine taxa reported new to Arkansas. This paper considers several taxa as distinct which were previously treated as synonyms by other authors. It reports two hybrids, and treats taxa excluded from the Arkansas flora, as well as taxa considered to be possible additions to the state's flora.

- 74 STALTER, RICHARD¹ and ERIC E. LAMONT² Department of Biological Science St. John's University, Jamaica, NY 11439 and ²New York Botanical Garden, Bronx, NY 10458- Rare and endangered vascular flora of North Carolina's Outer Banks, Shackleford Banks, to Virginia.

The Outer Banks are a chain of Atlantic Ocean barrier islands which extend from Virginia southward along the North Carolina Coast. The islands surveyed in this

floristic study include Bodie, Pea, Hatteras, Ocracoke, Portsmouth, North and South Core Banks, and Shackleford Banks. Collecting trips were made to the study area approximately once a month during the growing seasons from June 1989 through October 1996. *Polygonum prolificum* (determination verified by R. S. Mitchell [NYS]) is a new state record for North Carolina. Seventeen species occurring on the Outer Banks are listed as rare or endangered in North Carolina (Amoroso and Weakley 1995): *Amaranthus pumilus* (listed as Federally threatened), *Eleocharis cellulosa*, *E. halophila*, *E. montevidensis*, *E. rostellata*, *Helianthemum corymbosum*, *Hottonia inflata*, *Ipomoea stolonifera*, *Hudsonia tomentosa*, *Leptochloa fascicularis* var. *martima*, *Lilaeopsis attenuata*, *Ludwigia alata*, *L. lanceolata*, *Malaxis spicata*, *Polygonum glaucum*, *Rhynchospora odorata* and *Spiranthes laciniata*. This number of rare plant species is one of the highest for any area of equal size in North Carolina.

- 75 BRADLEY, TED. Dept. of Biology and the Center for Field Studies, George Mason University, Fairfax, VA 22030 – Contributions to the Flora of North Andros Island, Bahamas – Gobie Lake Blue Hole.

The Center for Field Studies at George Mason University and The College of The Bahamas have established a field station on North Andros Island. One of the projects initiated is a series of floristic collections from various habitats. A floristic list of Gobie Lake Blue Hole is the first report of the project. Voucher specimens of the flora are deposited at the herbarium of George Mason University (GMUF) and at the offices of the Ministry of Agriculture (Botanical Gardens at Nassau). A sedge, *Rhynchospora mtenis* (Vahl) Gray, is reported as new to the Bahamian Archipelago.

- 76 R. DALE THOMAS AND HERBERT YOUNG. Northeast Louisiana University, Monroe, LA. A checklist of the vascular flora of Ouachita Parish, Louisiana.

A list of the plants from Ouachita Parish is presented. This list was compiled from collections made by the senior author for the past thirty-one years. It also includes data from specimens in all of Louisiana's herbaria and those known from literature citations. Each taxon included in the list is documented by a herbarium specimen or a literature citation. Plants from the parish that are rare in Louisiana will be emphasized. A copy of the checklist will be available at the presentation.

- 77 JONES, RONALD L. AND CHARLIE LAPHAM. Eastern Kentucky University and Kentucky Native Plant Society-Index Kentuckiensis, a new approach for the manipulation and mapping of specimen data.

Index Kentuckiensis is a set of programs involving the use of GUI (Graphical User Interface) for specimen data collection, manipulation, and mapping. The current design is specifically directed toward vascular plant specimens in herbaria, but the programs can easily be modified for any group of specimens. This methodology consists of both routines and data from which multiple programs can be readily derived. It uses a popular and inexpensive database manager, mapping software available free over the Internet, and standard personal computers. Look-up tables, common to all users, assure that taxonomic and geographic data will merge properly and easily. Variable taxonomy is supported so that systematists with different taxonomic preferences can use the same data with equal ease. The look-up tables provide a quick method for entering much of the specimen label data, including the taxon name and family, and taxonomic training needs for data entry personnel are minimal. Customized labels and journal-quality dot maps can also be generated. Other special provisions include the ability to "tag" certain groups of records, such as those for noxious weeds (for tracking) and rare taxa (for protection of sensitive data). Datasets can be maintained for local herbaria or on a state-wide or region-wide basis. This approach has received wide approval among Kentucky curators, and is currently being implemented at several herbaria.

- 78 WATTS, TIFFANY AND MARK SCHORR. Dept. of Biological and Environmental Sciences, University of Tennessee at Chattanooga, Chattanooga, TN 37403 –Impacts of coal mine drainage on water quality and aquatic salamanders in a Cumberland Plateau stream.

Coal mine drainage has contributed to the widespread acidification of Appalachian streams, often resulting in poor water quality and the loss of aquatic biodiversity. Acid mine drainage (AMD) from deserted coal mines is responsible for water pollution problems in the Cumberland Plateau region of North Chickamauga Creek (NCC), a tributary to the Tennessee River near Chattanooga, Tennessee. We investigated the potential effects of AMD on stream water quality and aquatic salamander populations in the NCC system. Salamanders were collected by kick-sampling (using a rectangular net with 500- μ m mesh) and electroshocking at AMD-impacted sites (mean pH < 5.6) and reference sites (mean pH > 6.2), May-July 1996. Dusky salamander *Desmognathus fuscus* (89% of total) and total salamander abundances (all species) were lower ($P < 0.10$) at impacted sites versus reference sites, regardless of the sampling method. Dusky and total salamander abundances were directly correlated with pH ($r > 0.90$; $P < 0.05$) and inversely correlated with the concentration of dissolved aluminum ($r = -0.80$; $P < 0.10$). Preliminary findings from this study underscore the negative impacts of acid/metal pollution on stream-dwelling salamanders and provide baseline data for AMD-abatement projects.

- 79 LINDSEY, KRISTEN L., ROBERT A. ANGUS, AND KEN R. MARION. University of Alabama at Birmingham - Biological assessment of the effects of urbanization on an Alabama river using benthic macroinvertebrate populations.

Bioassessment studies were conducted along the Upper Cahaba River using benthic macroinvertebrate collections. Samples were taken at fifteen sites during four seasons: fall 1995, spring 1996, fall 1996, and spring 1997. Samples were collected in riffle areas with a kick net and preserved in EtOH. One hundred specimens were randomly selected for each site per season and identified to genus level with microscopic examination. Coarse particulate organic matter was also collected at each site per season and analyzed for presence and abundance of functional feeding groups. General trends were seen in the data suggesting that the diversity and abundance of macroinvertebrate population assemblages declined downstream of areas impacted by urbanization. Similarly, indices indicated that the pollution-sensitive groups declined in the same manner. Although anthropogenic sources of pollution, such as pesticides, treated waste water, and siltation, appear to be affecting some of the sites, none of the sites were assessed to be severely impacted. Data further suggest that the often recommended one hundred macroinvertebrates collected per site per season may not be sufficient in determining statistically significant trends in populations.

- 80 FREEMAN, PAUL, MARK SCHORR, AND CHARLES NELSON. Dept. of Biological and Environmental Sciences, University of Tennessee at Chattanooga, Chattanooga, TN 73403 - Comparative study of benthic macroinvertebrate assemblages in acid-polluted and reference streams in the North Chickamauga Creek system, Tennessee.

Acid mine drainage (AMD) from abandoned coal mines has polluted about 18 miles of streams in the North Chickamauga Creek (NCC) system, a tributary to the Tennessee River (R.M. 470.8) near Chattanooga, Tennessee. We conducted a two-year investigation of the potential effects of AMD on stream water quality (January-December), habitat structure (May-July), and benthic macroinvertebrate assemblages (May-June) in the Cumberland Plateau region of the NCC system, 1996-1997. Stream pH averaged 4.1 at two AMD-impacted sites and 5.7 at a nearby reference site; total dissolved aluminum averaged 2,500 μ g/L and 180 μ g/L, respectively. Gravel/cobble embeddedness averaged 57.3% at AMD-impacted sites and 12.6% at the reference site. A total of 3,184 benthic macroinvertebrates (>500 μ m) was collected by kick-net sampling in riffle habitats; taxa richness was 25 at the AMD-impacted sites and 38 at the reference site. Total macroinvertebrate abundance was significantly lower ($P < 0.1$) at the AMD-impacted sites versus the reference site. First-year results of this study document the negative effects of acid and metal pollution and physical habitat degradation on benthic macroinvertebrates in an AMD-impacted stream, and provide baseline data for ongoing/future reclamation projects.

- 81 CREWS, EVAN AND MARK SCHORR. Dept. of Biological and Environmental Sciences, University of Tennessee at Chattanooga, Chattanooga, TN 73403 -Potential of constructed wetlands to improve the water quality of acid mine drainage in the North Chickamauga Creek watershed, Tennessee.

North Chickamauga Creek (NCC) drains approximately 121 square miles of the Cumberland Plateau and Ridge and Valley ecoregions near Chattanooga, Tennessee. Acid mine drainage (AMD) from abandoned coal mines has degraded several miles of plateau streams in the NCC watershed. Experimental treatment systems (constructed wetlands) have been installed at two locations on Standifer Creek, a severely impacted tributary to NCC, in an attempt to improve water quality problems (acid/metal pollution) caused by AMD. Surface measurements of pH, conductivity, and discharge were taken monthly at AMD-influent and wetland-effluent sites, January-December 1996. Preliminary assessments of the two wetlands indicate

that influent discharges of acidic mine runoff and seepage exceeded the capacity of both systems to function properly. No substantial improvement in pH was observed, except during low-flow periods in July-August when mean pH values increased from 3.0 (influent) to 6.3 (effluent). However, notable improvements in pH during low-flow periods were negated by untreated mine seeps entering Standifer Creek from other point sources. These findings indicate that structural modifications to the existing wetlands are necessary to ameliorate AMD impacts. Moreover, additional wetlands are needed to improve water quality in the NCC system.

- 82 HUPP, CLIFF R. U.S. Geological Survey, Reston, Virginia - Woody debris, sedimentation, and vegetation relations in a forested wetland along the Cache River, Arkansas.

The generation, transport, and effects of woody debris have received considerable attention along relatively high-energy streams over the past two decades, but have received considerably less attention along low-energy streams with extensive forested wetlands, typical of the Southeastern U.S. Coastal Plain. Accumulations of woody debris racks, during the hydroperiod, on the upstream side of tree trunks create flow obstructions that alter surface roughness, sedimentation rates, soil-carbon dynamics, and, by raising microrelief, provide germination sites for natural stand restocking. Debris racks were characterized and coarsely quantified along transects across the Cache River, Arkansas, bottomland, and were then related to long- and short-term sedimentation rates, percent mineral soil, elevation, flow velocity, and the composition of woody vegetation. Preliminary results suggest that woody-debris volume per unit area is negatively related to elevation and flow velocity, and positively related to percent mineral soil and presence of bottomland hardwoods. The character and dynamics of woody debris in riverine forested wetlands may play a critical role in the functional value and continued species-compositional integrity of these systems.

- 83 MATTHEWS, CHRISTOPHER R.¹, E. MICHAEL WOLFE¹ and WILLIAM TINGLE². ¹HDR Engineering, Inc. of North Carolina, Charlotte, NC 28202 and ²Mecklenburg County Stormwater Services, Charlotte, NC 28202 - Performance of eight Piedmont plant species for use in stream restoration and bioengineering at Toby Creek, Charlotte, NC.

The use of bioengineering as a method of streambank stabilization is a growing trend in the Charlotte, NC area. Mecklenburg County Stormwater Services contracted with HDR Engineering to design, supervise and monitor the installation of an alternative channel restoration technique known as a floodplain bench that also incorporated bioengineering. Normally, species such as *Cornus amomum* and *Salix nigra* are used as live stake material in bioengineering. However, included in this project was the installation of vegetative test plots to determine the establishment success of eight other species of woody plants for potential use as live stake material. Three plots containing rows of randomized pairs of *Baccharis halimifolia*, *Callicarpa americana*, *Itea virginica*, *Lindera benzoin*, *Salix sericea*, *Symphoricarpos orbiculatus*, *Viburnum nudum* and *Xanthorrhiza simplicissima* were planted. Each pair had one individual that was treated with a rooting hormone and fungicide mixture while the other individual was left untreated. Monitoring after almost one year has determined that only three species survived in appreciable numbers, *Itea virginica*, *Salix sericea* and *Symphoricarpos orbiculatus*. Additionally, untreated individuals survived as well as treated individuals.

- 84 LONG, JEANNIE AND MARK SCHORR. Dept. of Biological and Environmental Sciences, University of Tennessee at Chattanooga, Chattanooga, TN 37403 - Effects of acid drainage from coal mines on stream water quality and fish assemblages in the North Chickamauga Creek system, Tennessee.

North Chickamauga Creek, a Cumberland Plateau stream which flows into the Tennessee River in southeastern Tennessee, has been impacted by drainage from abandoned coal mines. We designed a two-year study (1996-1997) to assess the effects of acid mine drainage (AMD) on stream water quality and fish populations in the plateau region of the North Chickamauga Creek system. Stream pH averaged < 5.5 at AMD-impacted sites and > 6.0 at reference sites. Fish assemblages were sampled at each site by hoop-netting quarterly (January-December), and by electrofishing monthly (May-July). Mean total fish abundance was greater ($P < 0.1$) in reference versus AMD-impacted sites. Seven fish species (mostly centrarchids and cyprinids) were collected at reference sites versus four fish species (mostly centrarchids) at AMD-impacted sites. Green sunfish *Lepomis cyanellus* have established populations in both reference and AMD-impacted sites. A comparison of mean length at age of capture (based on number of annuli observed on otoliths) revealed that green sunfish, ages 1 - 3, grew faster ($P < 0.1$) in reference versus AMD-impacted sites. Findings from this study serve to document the adverse effects of coal mine drainage on stream fishes and provide a benchmark for AMD-mitigation projects.

- 85 KOHNKE, LAURA L., STEPHEN P. VIVES, AND DAVID C. ROSTAL. Georgia Southern University - Effects of fish chemical and visual cues on behavior, growth, and age at metamorphosis of larval mole salamanders, *Ambystoma talpoideum*.

Responses of larval *Ambystoma talpoideum* to chemical and visual cues from two fish species, *Emmeancanthus obesus* and *Gambusia holbrooki* were examined in indoor aquaria and outdoor simulated ponds. Dependent variables of use of refugia, growth, and age at metamorphosis were measured. In aquaria, there was no significant difference between use of refugia between larvae raised in the presence of *E. obesus* and *G. holbrooki* compared to a control. However, larvae spent significantly more time under refugia during the first half of their larval period regardless of the treatment variable. Days to metamorphosis, size at metamorphosis, and growth rates were not significantly different between larvae raised in the presence of *E. obesus* and *G. holbrooki* compared to a control. In outdoor simulated ponds, choice of substrate (sand versus leaf litter) and growth rate were not significantly different between larvae in control ponds and ponds containing a caged *E. obesus*. Our data suggest that larval *A. talpoideum* do not react to the presence of potential fish predators by changing use of refugia, growth rates, or time to metamorphosis.

- 86 VESSELS, NICOLE AND JEFF JACK. Department of Biology, Western Kentucky University, Bowling Green, KY 42101 - The impact of vertebrate predation on microinvertebrate communities in a temporary karst lake.

Chaney Lake is a temporary karst wetland in Warren County, Kentucky. As a temporary habitat, it does not typically contain fish, but fish may be introduced to the lake via through connections to the subsurface Lost River Cave system. The purpose of our study was to isolate fish which were found in one area of the lake, and introduce these fish to another part of the wetland to assess the effect of fish predation on the microinvertebrate communities. Six 2x2x2 meter plastic-walled corrals were placed in the lake and anchored against the bottom. Golden shiners (*Notemigonus crysoleucas*) were caught by dip nets and six fish were introduced to each of three corrals; three corrals served as controls. The invertebrate communities were sampled in the corrals every four days for two weeks using a 7-cm diameter coring device. Samples were preserved in the field in 90% ETOH. The samples were sorted and enumerated in the laboratory using a dissecting microscope. The presence of fish suppressed the larger zooplankton species, but had no significant effect on smaller taxa (e.g. rotifers).

- 87 SMITH, GREGORY A. AND TERRY D. RICHARDSON. Department of Biology, University of North Alabama, Florence, AL 35632-0001 - Population dynamics of *Viviparus subpurpureus* in a temporary riparian wetland.

Viviparus subpurpureus is a common resident of many southeastern streams, but little is known about populations in temporary habitats. Monthly samples of *V. subpurpureus* were collected from a temporary bottomland hardwood wetland adjacent to the Tennessee River in north Alabama over a six month period. Results indicate the presence of three generations with sexual differentiation occurring in males at the end of the first year (7 mm in shell length) and in females during the autumn months of the second year. Snail density and biomass averaged 90 (± 11.5 S.E.) snails/m² and 2.6 g (± 0.4 g)/m², respectively. The male:female ratio was biased toward females (1:2.45). Females carried an average of 9.0 (± 1.2) embryos with the smallest impregnated female being 13.4 mm. Embryos did not appear in large numbers until the end of the dry season (September/October). It is highly unusual for a prosobranch snail like *V. subpurpureus* to inhabit a temporary site and it is uncertain how long this population has existed at this location. However, the presence of three generations, the older of which is still producing snails, suggests that life history characters have evolved for a drought resistant population.

- 88 BROWN, BRYAN L., DOBSON, WILLIAM E. AND CREED, ROBERT P. Dept. of Biology, Appalachian State University, Boone, NC 28608 - Distribution and abundance of an aquatic symbiotic worm (Annelida: Branchiobdellidae) on two sympatric species of host crayfish (Arthropoda: Crustacea)

Branchiobdellid annelids are symbiotes on freshwater crayfish. It has been stated in the literature that these annelids show no host preference within the local assemblages of freshwater decapods. We performed a survey of Branchiobdellid distribution and abundance on two sympatric species of crayfish, *Orconectes spinosus* and *Cambarus chasmodactylus*, in a section of the New River in Watauga County, North Carolina and found a significantly greater Branchiobdellid density on *Cambarus*. The average number of worms per crayfish for *Cambarus* was approximately eight times the average for *Orconectes*.

Regression using number of worms per crayfish as a response variable and carapace length of the host crayfish as a predictor, also revealed significant differences between the two hosts. These findings indicate bias in the host colonization patterns of this species of Branchiobdellid. Choice experiments are planned in order to determine if this bias in worm abundance results from branchiobdellid preference, host behavior, or combined effects of these two factors.

- 89 SOULEN, HEATHER L. AND FRANK JORDAN. Georgia Southern University and Loyola University - Distribution and habitat use of grass shrimp in the lower St. Johns River Basin, Florida.

We examined seasonal patterns of habitat use by grass shrimp along an estuarine gradient in the lower St. Johns River Basin, Florida. Absolute and relative abundance of *Palaeomonetes intermedius*, *P. paludosus*, *P. pugio* and *P. vulgaris* varied considerably along this estuarine gradient. In addition, all four species of grass shrimp were consistently more abundant in submerged aquatic vegetation than in adjacent sand flats. We performed laboratory behavioral experiments to identify the mechanisms responsible for patterns of habitat use we observed in the field. In the absence of predators, grass shrimp used vegetated and unvegetated portions of experimental tanks equally. With the addition of predatory largemouth bass (*Micropterus salmoides*), grass shrimp significantly increased use of the vegetated portion. Our field and laboratory studies indicate that grass shrimp assemblage of the lower St. Johns River Basin is structured by both abiotic and biotic factors.

- 90 TATE, NATALE AND DWAYNE WISE. Mississippi State University - The mechanism of mitosis in Chinese Hamster Ovary (CHO) cells undergoing division without prior replication.

Hydroxyurea (HU) is a powerful inhibitor of DNA synthesis. Chinese Hamster Ovary (CHO) cells treated with 2mM HU are arrested at the beginning of S phase. After 20 hours in HU, these cells can be forced to enter mitosis by a 9.5 hour treatment with 5mM caffeine (1, 3, 7 trimethylxanthine). As a result, the centromere-kinetochore complex detaches from the condensing chromatin and fragments. Nevertheless, cells so treated form normally functional spindles and undergo a mitosis-like division in which the unreplicated centromere-kinetochore fragments (CKFs) are separated into the daughter cells. Confocal scanning light microscopy using anti-tubulin and anti-kinetochore (CREST) antibodies shows that these spindles do not elongate prior to division. Therefore, the mechanism for anaphase B is either faulty or absent. Furthermore, the unreplicated CKFs are segregated into the daughter cells in approximately equal numbers. We have also investigated the disposition of the motor protein, CENP-E. Preliminary evidence indicates that this important protein behaves in a normal fashion in treated cells. Therefore, the absence of anaphase B cannot be attributed to malfunction of CENP-E. Our data imply that the specificity for chromatid separation resides in the spindle, not the chromosomes.

- 91 EDWARDS, ADRIENNE L. AND REBECCA R. SHARITZ. University of Georgia and the Savannah River Ecology Laboratory - Clonal diversity and local genetic structure of *Sagittaria isoetiformis* (Alismataceae) along an environmental gradient.

Environmental gradients have been shown to influence the population genetic structure and evolution of plants in terrestrial and salt water systems, but this rarely has been explored along freshwater gradients in wetlands. Local adaptation to freshwater gradients might be expected because water levels directly affect photosynthetic and/or respiration pathways in plants. We investigated the local colonization history and genetic structure of a rare wetland plant using horizontal starch gel electrophoresis. *Sagittaria isoetiformis* is a perennial monocot, 1-5 dm tall, with apparently short seed and pollen dispersal distances. Using 15 polymorphic allozyme loci, we mapped and surveyed up to 140 contiguous individuals in each of 4 m² plots in each of 3 water level transects. Average clone size differed in shallow versus mid- and deep-water plots. In addition, PGM and SKD allele frequencies varied significantly along the water gradient. These results suggest rapid sorting of genotypes in response to prevailing water levels since the population was established in 1990.

- 92 WISE, DWAYNE, SILVIA MARTIN, AND PILAR ARANA. Mississippi State University and Universidad Complutense - In meiosis of a grasshopper species, B chromosomes alter the metaphase checkpoint.

Populations of the Spanish grasshopper, *Eyprepocnemis pluriang*, are polymorphic for one or more of five different B chromosomes. These exist as univalent chromosomes and, up to now, have not been shown to have any effect on the fitness of their bearers. For this reason, B chromosomes are thought to be "selfish chromosomes": they carry no active genes and provide only for their own transmission

to the next generation. Using immunofluorescence cytochemistry and confocal scanning laser microscopy, we have shown that spermatocytes of *E. plurans* do not have the typical metaphase checkpoint. Little difference in kinetochore phosphorylation can be detected at various stages of meiosis I. Furthermore, in cells with B chromosomes, the phosphorylation pattern is completely altered. These data imply that B chromosomes survive in natural populations by delaying anaphase onset in meiosis.

- 93 HEIST, EDWARD J. AND JOHN R. GOLD Center for Biosystematics and Biodiversity, Texas A&M University, College Station, TX 77843-2258 -DNA microsatellite frequency and allelic diversity in the sandbar shark, *Carcharhinus plumbeus*, and blacktip shark, *C. limbatus*.

Subgenomic libraries were screened for di-, tri-, and tetranucleotide repeat motifs in the genomes of two highly vagile and commercially important shark species; sandbar shark (*Carcharhinus plumbeus*) and blacktip shark (*C. limbatus*). Microsatellite loci were found to be scarce in the genomes of both species relative to other vertebrates. Oligonucleotide primers for amplification of microsatellite loci via polymerase chain reaction were developed, and microsatellites heterozygosities were scored on denaturing polyacrylamide gels. Allele frequencies at several loci in each species were used to test the hypotheses that genetic stock structure exists within the western North Atlantic.

- 94 TURNER, THOMAS F. AND JOHN R. GOLD Center for Biosystematics and Biodiversity, Texas A&M University, College Station, Texas 77843-2258 -Population size? A case study of three classes of molecular markers surveyed in red drum (*Sciaenops ocellatus*) from the Gulf of Mexico.

Genetic information from managed fish populations is often used to estimate genetic effective population size, N_e . Managers must weigh the cost of genetic study (as determined in part by sampling effort) against potential benefits that are determined by the hypotheses that the data can address adequately (i.e. statistical power). This paper is a case study that examines statistical power to estimate N_e in red drum (*Sciaenops ocellatus*) through the use of genetic markers. Extensive genetic information available for this species permitted comparison of three commonly used classes of genetic markers (i) allozymes; (ii) mitochondrial DNA restriction fragment length polymorphisms (mtDNA-RFLPs); and (iii) microsatellite DNA loci. Statistical power analysis indicated that all three classes of genetic markers can estimate small genetic effective population sizes ($N_e < 500$) with high accuracy and statistical confidence, given a large number of individuals sampled. As N_e increases above 500, statistical power and accuracy differ among markers: microsatellites > allozymes, > mtDNA-RFLPs. Increasing number of independent loci increases statistical power more effectively than increasing number of alleles or number of individuals sampled. Indirect estimates of N_e from mtDNA-RFLP data indicate that effective population size of red drum is sufficiently large to preclude critical losses of genetic diversity to drift despite recent declines in abundance.

- 95 THOMPSON, ANDREW R., J. TODD PETTY, AND GARY D. GROSSMAN. Warnell School of Forest Resources, University of Georgia, Athens, GA 30602 - The Influence of Abiotic and Biotic Factors on Habitat Use by Longnose Dace, *Rhinichthys cataractae*, at Two Spatial Scales.

We examined the interactive effects of the physical environment and prey distribution on habitat use by a benthic stream fish, the longnose dace, *Rhinichthys cataractae*, at two spatial scales. At a microscale, dace avoided areas with high amounts of sand, silt and debris in summer and fall, 1996, and spring 1997. During spring and summer, dace occupied microhabitats with higher prey biomass than was available at randomly selected locations throughout the environment. In fall, there was no difference in prey biomass between locations where fish were observed and locally available microhabitats. At a reach scale, fish avoided reaches that contained high amounts of sand, silt, and debris in all seasons. Discounting the high-silt reaches, there was a significant, positive relationship between fish and macroinvertebrate densities among reaches in all seasons. A possible explanation for the lack of correlation between fish and macroinvertebrate densities at a microscale in fall was that macroinvertebrates were distributed in discrete patches in summer and spring, but not in fall. Our study demonstrated that both physical and biological factors can influence fish distributions and that patterns can vary seasonally.

- 96 DAVIN, WILLIAM, JODI HODGES, SUSAN BOWERS, CHRISTINA HOFFMAN, AND JEFF SERRERO. Department of Biology, Berry College, Mount Berry, GA. - Striped bass (*Morone saxatilis*) spawning activity and egg drift in the Upper Mobile River Basin.

Striped bass, an anadromous fish, has been stocked in various waters around the country, but few landlocked-reproducing populations have been established. This species has been stocked since 1972 into the Coosa River, Lake Weiss, Allatoona Reservoir, and Carters Lake in Northeastern Alabama and Northwestern Georgia. Ichthyoplankton samples were taken weekly during a three-month period (May to June, 1997) from three sites in the Upper Mobile River Basin, namely on the Coosa, Etowah, and Oostanaula Rivers in Georgia. A total of 1472 striped bass eggs were collected during a two-week period in May. The eggs were staged, based on developmental progression since fertilization, and this information, along with stream flow data and drift rates, was used to estimate possible spawning sites. The 1997 data suggests that the striped bass spawned in the Oostanaula River, upstream of Rome, Georgia.

- 97 ADAMS, S. REID AND JAN JEFFREY HOOVER. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, 39180-6199. - Habitat affinities of a highly endemic desert pupfish.

The White Sands pupfish, *Cyprinodon tularosa*, is endemic to the Tularosa Basin, New Mexico. In Apr-Sep 1997, we used floating light-traps to sample three populations at the White Sands Missile Range. Pupfish abundance (number/light-trap) was lowest at Mound Spring (15.31 ± 39.21 SD), an excavated, deep (> 2 m), 900 m² pond into which pupfish were apparently introduced. Pupfish were significantly more abundant in Salt Creek (56.79 ± 93.49 SD), a small (< 24 km), shallow (< 0.5 m) intermittent stream, and in Malpais Spring (48.85 ± 97.69 SD), a small (< 1 km), shallow (< 1 m) spring-fed system of stream and marshes. In Salt Creek, high pupfish numbers in a plunge pool (81.67 ± 107.35) and open desert channel (68.6 ± 110.19) were not significantly different than those for a narrow, shaded run (21.88 ± 29.09). At Malpais Spring, pupfish abundance was significantly higher (SNK, $p < 0.05$) in a spring run/marsh transition zone (55.44 ± 75.24) and in a marshy meadow (110.11 ± 151.41) than in a spring run and boil (3.58 ± 6.99). Multiple regression analysis indicated that depth was negatively correlated with and explained 28% of variation in pupfish abundance. Our data suggest that White Sands pupfish populations are limited by availability of permanent, shallow water habitats.

- 98 TIMMONS, TOM J., AND TYRONE A. HUGHBANKS. Hancock Biological Station, Murray State University, P.O. Box 9, Murray, KY 42071 - Exploitation and mortality of paddlefish, *Polyodon spathula*, in the lower Tennessee and Cumberland rivers.

We examined the paddlefish *Polyodon spathula* fishery in the lower Cumberland and Tennessee rivers. Exploitation was 20.0% in Lake Barkley (155 fish), 25.4% in the Kentucky Dam tailwater (185), and 14.4% in Kentucky Lake (174). Most of the exploitation was commercial in Kentucky Lake (88%), and sport in Lake Barkley (65%) and the Kentucky Dam tailwaters (64%). We compared the Kentucky Lake commercial paddlefish harvest during the winter spawning run of 1991-1992 with the 1985-1986 season. The 1985-1986 harvest followed high roe prices, resulting in high annual mortality (69%). Annual mortality was lower (32%) in 1991-1992. We aged sections from 245 jaws, representing age-classes 3-21 and a mean age of 10 years. Age of first reproduction was 6 years for males and 8 years for females. The majority of paddlefish were harvested in the lake where they were tagged, but a few individuals moved among the major tributaries of the Mississippi River. Even with total exploitation of 14.4%, the status of the paddlefish population in Kentucky Lake improved in 1992. There were more older paddlefish than observed six years before; the mean length and weight increased; and there were more gravid females. Area and seasonal closures have the greatest potential for effective management of paddlefish in Kentucky Lake.

- 99 SCHULTZ, DAVID L., JASON HOUSTON AND TAEGER GISCLAIR. Nicholls State University, Thibodaux LA 70310 - Egg size variation among populations of the Gulf pipefish, *Syngnathus scovelli*.

The Gulf pipefish (*Syngnathus scovelli*) is a highly euryhaline species with established populations in marine, brackish and freshwater habitats. Although the Gulf pipefish is not the only fish species known to be broadly euryhaline through its entire life cycle, this phenomenon is rare. This broad habitat range begs the question of what habitat specific adaptive adjustments have been made among populations in different habitats. The purpose of the work reported here is to survey life history variation within and among habitat types and document habitat specific life history differences. Here I report on the variation in egg mass

among populations. Among seven populations surveyed, mean egg dry mass varied from 340 μ g to 480 μ g. Statistically significant differences were found between freshwater, brackish, and marine populations, with freshwater populations having the largest eggs and marine populations having the smallest. These results suggest that adaptation to freshwater has selected for greater investment in individual offspring. Parental investment differences may reflect differences in exploitable productivity among the habitat types, or they may reflect differences in physiological stresses on larvae. The results of this work may lead to better understanding of the adaptive tradeoffs that must be made when a species invades new habitat types or adaptive zones.

- 100 SCHORR, MARK¹ AND MICHAEL MEADOR². ¹Dept. of Biological and Environmental Sciences, University of Tennessee at Chattanooga, Chattanooga, TN 73403 and ²United States Geological Survey, Water Resources Division, Raleigh, NC 27607 -Physicochemical characteristics of striped bass *Morone saxatilis* habitat during summer stratification in a large southern reservoir.

Summer die-offs of striped bass *Morone saxatilis* in southern reservoirs have been explained by the thermal niche-dissolved oxygen (DO) hypothesis, which states that healthy populations require summer water temperatures < 25°C and DO concentrations $\geq$ 2.0 mg/L. Such physicochemical conditions do not prevail in Lake Texoma, Oklahoma-Texas, a 35,200-hectare impoundment of the Red River; however, this reservoir supports a robust population of striped bass. We studied habitat utilization by striped bass and physicochemical gradients (temperature, DO, conductivity) during summer stratification (June-September) in Lake Texoma. Ultrasonic telemetry (striped bass) and physicochemical data collected from two independent studies (1989-90, 20 fish tagged; 1992-93, 25 fish tagged) provided concordant results. Tagged striped bass congregated in the deep main basin of the reservoir during summer stratification; these fish occupied lake depths of 6-9 m, temperatures of 24-25°C, and DO concentrations of 4-7 mg/L in June; and 1-3 m, 25-28°C, and 7-10 mg/L in July-September, respectively. Relatively high epilimnetic DO concentrations (>7 mg/L) and the high overall conductivity (>1,000 μ S/cm) of Lake Texoma may serve to reduce thermal stress in striped bass exposed to high summer temperatures.

- 101 KILLGORE, K. JACK, JAN JEFFREY HOOVER, AND JAMES P. KIRK. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi- Fish assemblages in borrow pits along the lower Mississippi river.

Borrow pits are being created during proposed levee construction along the lower Mississippi River. We evaluated relationships between pit morphometry and standing crop of fishes as part of documenting environmental impacts of the project. Eight pits were sampled with rotenone in late July 1996 and August 1997. Sixty-six species of fish were collected dominated taxonomically by sunfishes, minnows, catfishes, and suckers. Gizzard shad were numerically dominant. Fish abundance was correlated with 6 different physical variables, 3 of which were morphometric, 2 were water quality (turbidity and conductivity), one was hydrologic (annual days flooded). Species richness and abundance were consistently higher in deeper pits (>1.5 m depth during isolation) than in shallower pits. Frequency of flooding was an important correlate for some species, but fluctuating stage elevations, including rapid isolation of a pit as stages decline after spring floods, may reduce the importance of habitat selection as fish attempt to follow the moving terrestrial-aquatic zone. However, pits that are permanently isolated from the river were depauperate compared to riverside pits, and most were dominated by sunfishes. Overall, borrow pits greater than 10 acres that were relatively deep with irregular shorelines had the highest fishery value.

- 102 KIRK, JAMES P.¹, JAMES V. MORROW, Jr.¹, K. JACK KILLGORE¹ and HOWARD E. ROGILLIO². ¹U. S. Army Engineer Waterways Experiment Station, Vicksburg, MS 39180 and ²Louisiana Department of Wildlife and Fisheries, LaCombe, LA 70445 - Recommendations to Enhance the Gulf Sturgeon Recovery/Management Plan.

We advocate enhancements to methodologies, but not the objectives, of the Gulf Sturgeon Recovery/Management Plan based upon a 4-year study in the Pearl River system, Mississippi-Louisiana. Population modeling using numbers, age structure, mortality estimates, and a variety of recruitment functions is recommended to determine trends and status of Gulf sturgeon, *Acipenser oxyrinchus desotoi*, populations. We suggest that catch per unit effort data is insufficiently sensitive to monitor depressed Gulf sturgeon populations. Modeling is more appropriate in forecasting successful conclusion of the recovery phase than the proposed criterion of recruitment equalling mortality over a twelve year period. Simple population modeling, using readily available off-the-shelf software, provides managers a recovery trajectory that includes population size, age structure, and rate of increase. Modeling does not require more manpower, skill, or funding than the current methods and it provides greater insight into population dynamics.

- 103 BIELAWSKI, JOSEPH P. AND JOHN R. GOLD. Center for Biosystematics and Biodiversity, Texas A&M University, College Station, Texas 77843-2258 - A maximum likelihood approach to inferring phylogenetic relationships of the genus *Pimephales*.

The cyprinid genus *Pimephales* is a small group comprised of four species occurring east of the Rocky Mountains. Monophyly is supported by morphological, allozyme, and chromosomal characters. However, investigations of the phylogenetic relationships of these species have yielded three different hypotheses. Furthermore, analysis of mitochondrial DNA restriction-site data indicated short internodal branch lengths. Short internodal branch lengths and an absence of additional ingroup taxa, required to break up long terminal branches, suggests that long branch attraction might have negatively impacted phylogenetic analyses. To investigate this problem, a maximum likelihood approach was employed to analyze a new data set consisting of DNA sequences of the ND4I and ND4 genes. The likelihood method of Goldman (1993) was employed to test and reject inappropriate candidate models of sequence substitution. This method has the advantage that phylogenetic parameters do not have to be assumed in order to perform the tests. The mitochondrial DNA restriction-site data of Schmidt et al. (1994) was reanalyzed using maximum likelihood. Monte Carlo simulations were used to compare the probabilities that either likelihood and/or parsimony analyses could produce misleading results when such short internal branch lengths exist.

- 104 STRINGER, GARY L. Department of Geosciences, Northeast Louisiana University, Monroe, LA - Evolutionary development of Cretaceous teleosts: new evidence from otoliths.

Teleostean otoliths from the Maastrichtian Kemp Clay (Hunt County, Texas) have provided additional insight into the evolutionary development of the bony fishes. Cretaceous fish faunas have long been considered as more primitive in nature with little relationship to modern families. No definite perciforms based on osteological material have been reported from the Cretaceous. The development of modern teleost families has been traditionally considered as an Early Tertiary event. However, preliminary investigation of approximately 1000 otoliths from the Late Cretaceous Kemp Clay of Texas and other studies of Cretaceous otolith assemblages have indicated a significant number of taxa which belong to Recent families. These taxa include such forms as apogonids, pempherids, bathylupeiids, gempylids, and caproids and clearly indicate the presence of perciforms in the Cretaceous. The Kemp Clay otoliths as well as other Cretaceous otolith faunas from North America provide further evidence of the development of modern lineages of bony fishes in the Upper Cretaceous rather than the Early Tertiary. This earlier Mesozoic development allows perhaps 50 million years for the "modern" genera to evolve from the primitive, spiny finned fishes rather than the 20 million years allowed by a Tertiary development.

- 105 CLARK, CATHERINE M., THOMAS R. WENTWORTH, AND DAVID M. O'MALLEY. North Carolina State University - Phylogeographic variation in eastern North American *Abies*.

Chloroplast DNA simple sequence repeats (SSR's) or microsatellites offer new insights into phylogeographic differentiation and population history of the 3 eastern North American *Abies* taxa. Fraser (*A. fraseri*), balsam (*A. balsamea*) and intermediate (*A. balsamea* var. *phanerolepis*) fir populations are widely distributed geographically and adapted to diverse environments but show little morphological differentiation. We used SSR's to examine the distinctiveness of gene pools as well as the concurrence of molecular markers with morphological characteristics in the 3 taxa. DNA was PCR-amplified from range wide representatives of *Abies* and screened with 20 primers developed for SSR sites found in the complete sequence of the *Pinus thunbergii* chloroplast. Two of the primers show a high degree of polymorphism and chloroplast haplotype diversity as well as geographic differentiation. A high degree of polymorphism in a haploid, non-recombining and usually paternally inherited genome makes these molecular markers useful in delineating species and populations for conservation and management.

- 106 HERR, J. M., JR. University of South Carolina - On the origin of leaves: the telome theory revised.

According to the telome theory, leaves (megaphylls) originated from isotomous, cruciate branches of dichotomous shoot systems (e.g., *Rhynia*). Reduced growth in alternating branches of successive dichotomies, *overtopping*, formed lateral branch sets. The cruciate branches were reoriented to one plane (*planation*) followed by lateral fusion (*syngensis* or *webbing*) to form flat, isotomously veined laminae. Revision of the telome concept here is based in part on development of primary leaves in some ferns (e.g., *Woodwardia virginica*) that have shown minimal change since their origin. In a *Rhynia* type shoot system, reduced growth in alternating branches of successive dichotomies (anisotomy) accomplished *overtopping* and the establishment of lateral *indeterminate* sets of isotomous, cruciate branches. In each set, progressive growth reduction basipetally established a *determinate* branch system, the most primitive expression of a new

structure — the leaf. With a change from three to two division planes in the apical cell of each initial lateral truss, the branches became flat instead of cylindrical (*fasciation*). The elements of each lateral system thus appeared collectively as a deeply divided, simple leaf with dichotomous cruciate lobes. A gradual or sudden increase in the rate of basipetal growth reduction produced a shallow-lobed lamina, not by lateral fusion of adjacent free elements (*webbing*), but by failed separation following branch (lobe) initiation. The intact blade in early ontogeny was curved because of the cruciate placement of the second dichotomy. Flattening occurred at the third set of dichotomies where basipetal reduction of growth forced *planation* on the cruciate system. Divided and compound leaves evolved later with a resurgence of anisotomous growth within simple laminae.

- 107 MOORE, DEBRA S.¹, KEN R. MARION², AND SCOTT F. MICHAEL².
¹University of Montevallo and ²University of Alabama at Birmingham-
Relationships among the Southeastern *Hyla* as revealed by mitochondrial
cytochrome b sequence analyses.

The treefrogs of the genus *Hyla* constitute a large portion of the anuran community OF the southeastern United States. Six species (*Hyla avivoca* Viosca, *H. chrysocelis* Cope, *H. cinerea*(Schneider), *H. femoralis* Bosc, *H. gratiosa* LeConte, and *H. squirella* Bosc) have a broad area of overlapping ranges throughout parts of southern Georgia, Florida, Alabama, and Mississippi. *H. andersonii* Baird has a more restricted range within this broad area. Large assemblages of these species account for a substantial amount of the amphibian biomass in these areas. Variable in morphology, these frogs occupy many different niches, both spatially and temporally. While it is understood how this partitioning has served to reproductively isolate species using the same macroenvironment, it is not clear how groups which overlap either in reproductive season or microhabitat use have maintained separate genetic identity. Relationships within this diverse genus are examined using mitochondrial cytochrome b sequence analyses.

- 108 House, Russell F. and Jeri W. Higginbotham. Dept. of Biology, Jacksonville State University, Jacksonville, AL 36265 -C. C. Pond: A Quaternary pollen sequence from northeast Alabama.

A 260 cm sediment sequence from C. C. Pond, Calhoun and Talladega Counties, Alabama, spans the last 33,100 years and has yielded a pollen record of changes in plant community structure through the last full-glacial interval. Five distinct pollen zones were recognized: an oak-maple zone from 33,100-26,500 yrs B. P., a *Pinus*-Betulaceae zone from 26,500-14,670 yrs B. P., a *Betula*-*Alnus* subzone from 18,000-16,000 yrs B. P., a *Fagus*-*Nyssa* zone from 14,670-6,000 yrs B. P., and a *Nyssa*-*Pinus* zone from 6,000-0 yrs B. P. The oak-maple zone represents an interstadial period prior to the full-glacial interval. Forests of this period were similar to the modern mixed mesophytic climax. Peaks in the representation of oak (*Quercus*), maple (*Acer*), and other deciduous taxa indicate a warm-temperate forest community with a relatively long growing season, mild winter temperatures, and low drought stress. The *Pinus*-Betulaceae zone represents the local forest community during the full-glacial interval. This community was interrupted between 18,000-16,000 yrs B. P. by a northern hardwoods-type forest in which birch (*Betula*) and alder (*Alnus*) were dominant in the forest canopy. The early Holocene is represented by the *Fagus*-*Nyssa* zone, which represents a variant of the mixed mesophytic association. *Fagus* was the most dominant canopy tree in this cool, moist postglacial period. The *Nyssa*-*Pinus* zone represents the establishment of the modern flora. C. C. Pond is one of comparatively few sites in the Southeast which serve to clarify the nature of vegetation changes in response to the last glaciation

- 109 RADENBAUGH, TODD A. Canadian Plains Research Center, University of Regina, SK, Canada S4S 0A2 - Spatio-temporal ecological scales on the Canadian Prairie Ecoregion.

The fossil record illustrates that throughout the Phanerozoic dynamic processes have repeatedly restructured biophysical systems from the level species to ecosystems. Further, biological innovations have occurred resulting major changes in ecological interactions. Recent fossil evidence suggests that biophysical systems remain stable or reoccur for extended periods and appear to be resilient to many physical disturbances such as climatic or sea level change. However, the periods of biological stasis are followed by punctuated intervals of abrupt change where species lineages undergo local extinction, rapid speciation, and immigration, resulting in the establishment of new biological systems. The mixed grasslands of North America are among the most altered ecosystems by human interactions. Human innovations reallocate energy, space, and habitat away from native systems through the construction of human-dominated agroecosystems. Three spatio-temporal units are examined in terms of sustainability and alteration: Population, Species Assemblage, and Ecozone. Human innovation affects each of these units differently since the structure of smaller-scales is extrinsically driven, and as they increase, structure

becomes both less stochastic and internally driven. Consequently, impacts at one scale may influence both the persistence and sustainability of others. The alteration of these units, and the subsequent creation of new ecospace, is having a major influence on the hierarchical structure of grasslands.

- 110 MCELROY, TOM C. AND WALTER J. DIEHL. Mississippi State University - Heterosis in the earthworm *Eisneia fetida andrei*: interactive effects of ontogeny and environment.

Biweekly fresh weight was measured of earthworms raised in all combinations of 2 soil moistures (2, 3 ml H₂O/g peat moss) and 3 temperatures (15, 20, 25°C; N=488) until constant weight was reached. Genotypes of 6 allozyme loci were resolved by starch-gel electrophoresis. Fresh weight of heterozygotes relative to that of both homozygotes was evaluated using a modification of Griffing's (1990) potency index (Hp) that was computed for each locus, environment and sample time in ontogeny. Heterosis was indicated when $H_p > 0$. Environment and ontogeny interacted to affect Hp at each locus individually ($P < 0.0001$) and at multiple loci ($P < 0.0001$). Depending on locus and environment, Hp increased, decreased or remained the same through ontogeny. Nevertheless Hp was typically positive for individual loci and environments throughout ontogeny. Overall multilocus Hp was greater than zero ($P < 0.001$) suggesting that at least a low-level heterosis persists in populations exposed to environmental variation. Supported by NSF grant DEB-9221094 to WJD.

- 111 O'CONNELL, MARTIN T. University of Southern Mississippi -Does the temporary habitat of an inundated floodplain offer increased food resources to fishes in a low order, blackwater stream?

Although the importance of floodplains to fishes has been established for large rivers, the actual mechanisms which yield benefits are less understood in smaller order streams. In a low order, blackwater stream of the Gulf Coastal Plain, fishes are consistently found on the briefly (3-5 days) inundated floodplain. Previous research suggests that these fishes are not using the inundated floodplain for spawning. Alternatively, fishes may be on the inundated floodplain to exploit increased food resources. I addressed this possibility by comparing the gut contents of fish enclosed on the inundated floodplain with the gut contents of fish enclosed in the stream during low water conditions. Cherryfin shiners, *Lythrurus roseipinnis*, were placed in enclosures and allowed to feed during three floods and subsequent low water periods (February to May, 1997). Analyses of gut samples of 211 *L. roseipinnis* from these experiments show that fish enclosed on the inundated floodplain ate more than fish enclosed in the low water stream (mean gut contents weight/total weight $\pm 95\%$ CI: floodplain = 0.0103 ± 0.0020 , low water = 0.0062 ± 0.0017). Fish enclosed on the inundated floodplain consumed more items of a terrestrial origin than fish enclosed in the low water stream (percentage of total items consumed: floodplain = 40.0% terrestrial, low water = 18.6% terrestrial). These results suggest that the inundated floodplain represents a source of increased food resources for stream fish in a low order, blackwater stream.

- 112 HEINS, DAVID C.¹, SCARLET S. SINGER¹, AND JOHN A. BAKER². ¹Department of Ecology, Evolution, and Organismal Biology, Tulane University, New Orleans, LA 70118 and ²Department of Biology, Clark University, Worcester, MA 01610 -The cooccurrence of reproduction in female threespine stickleback, *Gasterosteus aculeatus*, and parasitic infection by the cestode *Schistocephalus solidus*.

The threespine stickleback is an intermediate host of the cestode *Schistocephalus solidus*. Prior research has concluded that spawning is improbable among heavily infected stickleback females because *Schistocephalus* delays or inhibits ovarian maturation. Stickleback females that do spawn either are uninfected or do not show the major effects of *Schistocephalus* infection until after reproduction. The intensity, prevalence, and severity of infection of stickleback from Walby Lake, Alaska, show that reproduction and high levels of infection may cooccur. Our data suggest there may be previously unobserved adverse effects of parasitism on clutch parameters in parasitized stickleback females.

- 113 CASHNER, ROBERT C., MICHAEL A. POIRRIER, CHRIS SCHIEBLE, JEFF STEWART AND JULIAN M. HUMPHRIES. Dept. of Biological Sciences, University of New Orleans, New Orleans, LA 70148 - Temporal and spatial patterns of fish distribution in the Lake Pontchartrain estuary.

A recent survey of the nekton of the Lake Pontchartrain estuary was begun in Fall, 1996, and is currently in progress. Quarterly collections are made by trawl and/or seines at 14 stations approximating sites surveyed earlier by Suttkus et al. (1954) and Thompson and Verret (1980). The first full year of the present study (1996-97) yielded nearly 50 species of fishes. The numerical dominants, thus far, are bay anchovy, *Anchoa*

mitchilli, Atlantic croaker, *Micropogonias undulatus*, and gulf menhaden, *Brevoortia patronus*, the same rank order reported by Thompson and Verret (1980). Data on community similarity and faunal change will be reported. Comparisons of fish collections made prior to, during, and after the opening of the Bonnet Carré Spillway and during the March to late June algal bloom will be presented. A fish kill in Bayou St. John on June 16, 1997 will also be discussed. Among the 22 species identified from this kill were five specimens of Rio Grande perch, *Cichlasoma cyanoguttatum*. This is the first published record for this species in Louisiana.

- 114 PAXTON, CHRISTOPHER J. University of Tennessee, Knoxville - Life history of the redband darter, *Etheostoma luteovinctum*.

A life history study of the redband darter, *Etheostoma luteovinctum*, was conducted from March 1996 to June 1997 in Titan Creek, Duck River system, Maury Co., Tennessee. Titan Creek is a second order stream that flows southwest forming the western border of the SATURN Corporation site. Adult and juvenile redband darters were found to inhabit small pools, riffles, and runs. Both sexes reach maturity at one year of age at total lengths of 50-55mm. Sexual dimorphism in breeding color is distinct. Spawning occurred from February through late April in small riffles. Video tape of aquarium spawnings as well as on-site observations show female redband darters to be an egg burying species and fractional spawner. Stomach dissection revealed a diet that consists of dipteran larvae, primarily chironomids, and minute crustaceans. Rapid growth was observed in aquarium-reared individuals with males growing faster than females. Maximum age and size is attained at 2+ years. A population estimate based on a three pass depletion technique revealed that redband darters are abundant at the study site.

- 115 KEELAND, BOBBY D.¹, JAMES A. ALLEN², HARVEY KENNEDY³, AND ANDY CLEWELL⁴
¹USGS, National Wetlands Research Center Lafayette, LA, ²USDA Forest Service, Pacific Southwest Research Station, Honolulu, HI, ³USDA Forest Service, Southern Hardwoods Laboratory, Stoneville, MS, and ⁴A.F. Clewell, Inc., Quincy, FL - Introduction to "A Guide to Bottomland Hardwood Restoration."

The most dramatic wetland loss in the entire United States has occurred in the forested wetlands of the Lower Mississippi Alluvial Valley. Within the states of Arkansas, Louisiana, and Mississippi an original area of about 8 million hectares has been reduced to fewer than 2 million hectares. As of the mid-1990's, forested wetlands still suffer the greatest losses of all wetland types. Although this represents a dramatic loss of wetlands, it also indicates an opportunity to reforest lands that have historically supported bottomland hardwood and swamp forests. Restoration of these areas, however, is not a simple matter of planting trees as success has been highly variable. The US Geological Survey, US Forest Service, and private industry have joined together to create a manual outlining recommended procedures for restoring bottomland hardwood forests in the Southeastern United States. The manual covers topics such as: General Planning Considerations, Site Evaluations, Species Selection, Site Preparation, Seed and Seedling Collection, Direct Seeding, Planting Seedlings, Establishing Undergrowth, Weed Control, and Monitoring.

- 116 OUCHLEY, KEITH AND WYLIE C. BARROW, JR. School of Forestry, Wildlife, and Fisheries, LSU, Baton Rouge, LA 70803 and U.S.G.S., National Wetlands Research Center, Lafayette, LA 70506 - Characteristics of Old-growth Bottomland Hardwood Forests of the Lower Mississippi River Alluvial Valley in Louisiana.

Little quantitative information has been presented concerning the original pre-settlement composition and structure of bottomland forests in the Mississippi River Alluvial. We present a review of historical data gathered in some of the last remaining large tracts of old-growth bottomland hardwood forest in Louisiana. Early workers described as many as 8 forest types based on the species composition in each type. Variation in types was due primarily to compositional changes influenced by elevation and degree of flooding. Average volumes of timber in old-growth stands contained as high as 35,000 board feet per acre (bfa) on drier sites, to approximately 6,000 bfa on wetter sites. Individual trees on drier sites scaled as high as 8,000 board feet of merchantable timber. These forest contained an average of 75 to 150 trees per acre that were of a large variety of age and size classes, with canopy heights often exceeding 100 ft. This heterogeneous mix of ages and sizes presented a structurally diverse or multi-layered forest. Sweetgum (*Liquidambar styraciflua*) was found in high abundance in many sites and this species was one of the largest, in terms of height and diameter, and also one of the longest lived of any species sampled.

- 117 DELOACH, JUDY O. AND TIMOTHY L. DAVIS. U. S. Army Corps of Engineers, Memphis District - The U.S. Army Corps of Engineers Role in Regulating Bottomland Hardwood Wetlands.

Section 404 of the Clean Water Act authorizes the U.S. Army Corps of Engineers (Corps) to regulate the excavation and discharge of fill material and mechanical clearing of woody vegetation into waters of the United States. Jurisdictional bottomland hardwood wetlands are the most controversial waters of the United States to regulate because they are not easily recognized as waters of the U.S. The Corps determines whether a site is a jurisdictional wetland by collecting data on the soil, vegetation, and hydrology parameters. They work with the landowner or applicant through the permitting process to avoid, minimize, and mitigate adverse impacts to waters of the U.S. Many permits issued have mitigation requirements that involve replacement or creation of hydrology and reforestation. Enforcement is also a part of the Corps regulatory authority. Violations of the Clean Water Act in jurisdictional bottomland hardwood wetlands may include unauthorized ditch construction, mechanical clearing and filling for conversion to facilitate farming or urban development or levee construction to create greentree reservoirs. Whether processing a permit for proposed work or a violation for work completed, jurisdictional forested wetlands is a sensitive issue.

- 118 HAYNES, RONNIE. U.S. Fish and Wildlife Service. Atlanta, GA - Bottomland forest re-establishment in the lower Mississippi River Valley.

Since 1987, the U.S. Fish and Wildlife Service (Service) has planted approximately 62,000 acres of bottomland trees in the Lower Mississippi River Valley (LMR) through the Partners for Wildlife Program. Through all Federal government efforts (does not include mitigation plantings), between 195,000 and 200,000 acres of bottomland trees have been planted since 1987. Much of this is a result of conservation provisions of the various Farm Acts (e.g., Conservation Reserve Program and Wetland Reserve Program). The Service's primary objective for planting bottomland trees within the LMR has been simply to ensure a heavy-seeded oak component, and cypress when appropriate, on large (typically greater than 150 acres) tracts of marginal agricultural lands made available through abandonment or the voluntary actions of private landowners. This objective must be approached with a full understanding of the existing hydrologic site conditions, as well as realistic opportunities for restoring hydrology on specific sites, and the various site conditions and tolerances required by the trees to be planted. This presentation will address biodiversity issues, concepts, and management philosophies based on our limited monitoring information from plantings in the LMR since 1987.

- 119 BROWN, CYNTHIA R., MARK SWAN. The Nature Conservancy - Conservation Planning and Implementation in the Mississippi Alluvial Valley.

Getting a bird's-eye view of the Mississippi Alluvial Valley (MAV) is very important when determining where to invest limited reforestation dollars. Bird conservation leaders in the MAV -- Lower Mississippi Valley Joint Venture, Partners in Flight, Western Hemisphere Shorebird Reserve Network, state wildlife agencies, academia, private landowners, The Nature Conservancy, Tennessee Conservation League -- have developed the MAV Migratory Bird Plan which is helping focus reforestation efforts based on habitat needs for migratory birds.

Utilizing a Geographic Information System (GIS) and the knowledge of land managers and others with decades of experience in the MAV, information on forest acres, configuration, landform type, reforestation potential, ownership, time-since-clearing, and current land use has been gathered. These data have allowed us to identify approximately 90 priority conservation areas that, through reforestation, will achieve forest block goals of either 10,000, 40,000, and 100,000 acres. It is thought that these block sizes are necessary to support viable populations of Swainson's Warbler, Cerulean Warbler, and Swallow-tailed Kite, respectively. The assumption is that conservation and reforestation of habitat needed by these "umbrella" species will account for the needs of all native forest-nesting birds. The Nature Conservancy is developing supplemental information on community and species occurrence and distribution which will enable a further refinement of MAV migratory bird habitat objectives in order to target limited resources to areas having the greatest potential to provide optimal habitat for all elements of biodiversity.

- 120 WILLIAMS, HANS M. Stephen F. Austin State University - Restoration techniques in bottomland hardwood forests.

The Wetlands Reserve Program and mitigation required by Section 404 of the Clean Water Act have caused an increase in the reforestation of frequently-flooded agricultural land to bottomland hardwood wetlands (BLHW). The primary goal is to restore the physical and biological functions of BLHW. The successful establishment of seedlings depends on quality planting stock and a quality planting. Ensuring quality planting stock requires proper decisions about the species to plant, seed

sources, and stock-types. Proper seedling handling after they leave the nursery is critical. A quality planting depends on proper site selection, especially understanding the soil and hydrology characteristics. Matching the species to be planted to the specific soil and hydrology conditions can be facilitated by good on-site supervision during planting.

- 121 MCCOY, JOHN W.¹, BOBBY D. KEELAND¹, and JAMES A. ALLEN². ¹USGS, National Wetlands Research Center, Lafayette, LA, and ²USDA Forest Service, Pacific Southwest Research Station, Honolulu, HI - Natural Establishment of Woody Species on Previously Farmed Bottomland Hardwood Sites

The natural establishment of woody seedlings on abandoned agricultural fields was investigated at Lake Ophelia National Wildlife Refuge in Louisiana and at a site in Sharkey County, Mississippi. A series of paired transects originating at forest edges and oriented in cardinal directions were established in each area; each transect consists of eight 10x10m plots spaced at 20 m intervals. One of each pair of transects was disked. Seedling recruitment was dominated by sweetgum, sugarberry, and elms at both sites. Seedling establishment was significantly affected by direction from mature forest, disking, and by distance from mature forest. Less than half of the variation in seedling numbers per plot was explained by the effects of direction, distance, and disking, suggesting that other factors play an important role in seedling recruitment.

- 122 HOOVER, JAN JEFFREY AND K. JACK KILLGORE. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, 39180-6199 - Fishes of bottomland hardwood wetlands.

William Bartram, in 1791, identified bottomland hardwood wetlands as high-water avenues of fish dispersal, low-water refugia from desiccation, and areas of high production. Fish ecologists, during the past 20 years, supported and expanded upon these observations with quantitative data. Sixty-five species, characteristic of bottomland hardwoods, are dominated by elongate, surface-dwelling fishes (30 spp.), and deep-bodied, phytophilic sunfishes (12 spp.). Most species are small (< 80 mm), tolerate hypoxia, and exhibit high reproductive investment. Assemblages consist of 56-100% of species occurring locally. Rarefaction analyses of published data indicate high diversity in Gulf slope systems (29-41 spp/600 fish). Bottomland hardwoods are used sequentially as spawning grounds. Characteristic chronology of larval fishes occurring between 15 - 25 °C is: buffalos > darters > black basses > herrings and silversides > sunfishes and minnows. In the Mississippi Delta, high abundances of larval fishes are found in wetlands adjacent to large acreages of forest. Regression models of larval fish abundance and physical habitat parameters identify several factors correlated with spawning of individual taxa. Water depth and temperature, however, are frequent correlates. Value of bottomland hardwoods to fish biodiversity is emphasized by the occurrence of 30 regionally imperiled species.

- 123 FANT, MICHEAL AND JEFF JACK. Department of Biology, Western Kentucky University, Bowling Green, KY 42101 - Survey of invertebrate communities in a temporary karst wetland.

Chaney Lake is a seasonal wetland in Warren County, Kentucky which fills annually beginning in the late fall when precipitation causes the subsurface drainage to overflow onto the surface. This lake has several easily identifiable sub-habitats, and the purpose of our study was to perform a preliminary survey of the invertebrate communities at Chaney to determine if any general correlations could be drawn between invertebrate community structure and sub-habitat. Samples were taken at least twice monthly at 72 stations scattered throughout the various habitats from May 29th until August 5th, when the wetland had completely dried. Samples were obtained by hand using a 7 cm coring device and were preserved in the field in 90% ETOH. Samples were later enumerated in the laboratory. Preliminary results indicate that there are differences in invertebrate community structure in the different habitats, with the densities of some zooplankton taxa being significantly higher in the open areas of the marsh as opposed to the forested areas. Correlations with water chemistry parameters may provide explanations for the observed distributions of invertebrates.

- 124 GEORGE, STEVEN G.¹, CHARLES ALLEN², AND MALCOLM F. VIDRINE³. ¹Dyntel CZP, CEWES-ER-A, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199 and ²Dept. of Biology, Northeast Louisiana University, Monroe, LA 71209 and ³Dept. of Biological Sciences, Louisiana State University at Eunice, Eunice, LA 70535 - A survey of the freshwater mussels (Mollusca: Unionidae) from Brushy and Walnut Bayou, in Northeast Louisiana.

Twelve species of freshwater mussels were collected from 30 stations along a 43 kilometer course of Brushy and Walnut Bayous, headwater tributaries of the Tensas River in Louisiana. Numerically dominant mussels were *Pyganodon grandis* (Say, 1829), *Utterbackia imbecillis* (Say, 1829), and *Ligumia subrostrata* (Say, 1831) which together comprised 92.6% of the bivalves at twenty-five of the stations. Less abundant species included: *Unio merus tetralasmus* (Say, 1831), *U. declivus* (Say, 1831), *Anodonta suborbiculata* Say, 1831, *Quadrula apiculata* (Say, 1929), *Lampsilis teres* (Rafinesque, 1820), and *Leptodea fragilis* (Rafinesque, 1820) and *Toxolasma texasensis* (Lea, 1857). Rare mussels represented by single individuals were *Amblema plicata* (Say, 1818) and *Arcidens confragosus* (Say, 1829). All represent new records for these bayous. Vouchers of each were deposited in the mollusk collection at the Museum of Natural History in Jackson, MS.

125

BARRERAS, BLANCA E. AND FRANK A. ROMANO. Jacksonville State University - A preliminary analysis of a distributional survey of riparian zone Tardigrada of Choccolocco Creek, Alabama.

A distributional survey of riparian zone tardigrade populations of Choccolocco Creek, AL was undertaken. Choccolocco Creek is a 113.6 km (71 mile) long creek that begins in the southern terminus of the Appalachian chain (Dugger Mountain area) and flows southwesterly to join the Coosa River near Pell City, AL. Six stations were sampled that represented different physiographic portions of this creek, i.e., headwaters, midwaters, and mouthwaters. At each sampling site several trees with moss growths were selected and seasonal collections were made from August 1994 through December 1995. A total of 108 samples were collected of which 89 have been analyzed. A total of 1660+ tardigrades have been extracted from, comprising 2 classes and at least 7 genera, including *Macrobiotus*, *Minibiotus*, *Milnesium*, *Echiniscus*, and *Pseudechiniscus*. From this collection, tardigrades are more abundant during the Fall (400+) and Spring (400+) seasons with a decline in numbers from the Winter (200+) collection and a further decline in Summers (100+). No other differences between sites has been noted to date.

126

NICHOLS, PHILLIP B. AND FRANK A. ROMANO. Jacksonville State University - A preliminary survey on the distributional and altitudinal population patterns of Tardigrada on Dugger Mountain, Alabama

A survey of terrestrial tardigrade populations on Dugger Mountain, AL was undertaken. This mountain is the second highest peak in Alabama and part of the southern terminus of the Appalachian chain. The southeastern slope of Dugger Mt. was surveyed, within the South Fork of Terrapin Creek watershed, to identify dominant species, seasonal, and/or altitudinal population patterns. Tardigrades were collected from three stations with altitudes of 198, 360, and 562 meters. Each station, located along a stream valley, has 5 study sites positioned upslope, above the riparian zone, at midslopes and/or peaks. A total of 530+ tardigrades have been extracted, comprising approximately 6 genera. No significant elevational differences have been noted from this collection. Yet, an abundance pattern seems to be developing, with a larger number of tardigrades located at the midslope sites than at either the base or peak sites.

127

ROMANO, FRANK A., GEORGE R. CLINE, AND PAUL ROGERS. Jacksonville State University. A preliminary analysis of a distributional survey of terrestrial Tardigrada from Hawk Mountain Sanctuary, Hawk Mountain, PA.

A distributional survey of terrestrial tardigrades on Hawk Mountain, PA was undertaken. Hawk Mountain wildlife sanctuary is located in southeastern Pennsylvania (northern Berks and southern Schuylkill counties) and has an elevation of 464 meters (1521 ft). Hawk Mountain, was established in the 1930's by Rosalie Edge as the first raptor sanctuary in the world and encompasses 2,400 acres. Moss and lichen specimen, from rocks and tress, were randomly collected from widely distributed areas around the sanctuary and stored in paper bags during the summers of 1996 and 1997 by George Cline and Paul Rogers (from JSU). Stored, dried samples were rehydrated and tardigrades were extracted following the methodology of Nelson (1975). Extracted tardigrades were mounted in Hoyer's medium on glass slides for identification. A total of 15+ tardigrades have been extracted from 9 samples of the 1996 collection, comprising 2 classes and 3 genera, including *Macrobiotus*, *Milnesium*, and *Echiniscus*. Summers are generally a poor time to collect tardigrades and the low numbers are not suprising. It will be interesting to note if differences occur between the summers. 1996 was a wet summer while 1997 was a dry summer.

- 128 TOWNSEND, VICTOR R., JR. AND BRUCE E. FELGENHAUER. Dept. of Biology, University of Southwestern Louisiana, Lafayette, LA 70504-2451 - Cuticular scales of spiders.

The cuticular scales of 30 species of spiders from 11 different families were examined using scanning electron microscopy. The purpose of this study was to evaluate the criteria used by previous studies to distinguish cuticular scales from other types of setae in spiders. Our results indicate that each species examined in our study had scales that had a bent pedicel and were dorso-ventrally flattened. Most scales also exhibited a reduced socket morphology and had marginal spines. Other features of scale microanatomy including plicae, inferior spines, and setules were observed in relatively few (1-3) species. Our results also indicate that scale morphology varies tremendously both within and between families. We are currently investigating the phylogenetic significance of this variation in the Oxyopidae and the Dionycha.

- 129 TREADAWAY, REX A. AND STEPHEN C. LANDERS. Dept. Biological Sciences, Troy State University, Troy, AL 36082 - Feeding experiments with the ciliated protozoan *Hyalophysa chattoni*, an ectocommensal of the grass shrimp *Palaemonetes*.

The ciliated protozoan *Hyalophysa chattoni* lives encysted on a crustacean host. At molting, the ciliate excysts and feeds within the exoskeleton on exuvial fluid. The trophont expands to many times its original size during this period, which is its only opportunity to feed in the life cycle. The fed cell is little more than a rim of cytoplasm stretched around a large food vacuole, which must settle and divide into infective daughter tomites. We have studied endocytosis in the trophont using nigrosin and congo red. In separate experiments, one of the dyes was either injected into a freshly molted exoskeleton containing trophonts or was injected into the water with the premolt shrimp. Both dyes were incorporated into the food vacuole during feeding and were present in later stages of food vacuole division. Labelled vesicles appeared in the tomita stage, and had concentrated amounts of the dye. We have not observed a color shift in the ingested congo red from orange-red to blue, indicating that the food vacuoles do not undergo an acidification in the trophont stage. Further results regarding the cytostome will be presented.

- 130 BURDEN, B., K. TINDALL, AND L. HARGIS. Dept. Biological Sciences, Louisiana State University-Shreveport, Shreveport, LA 71118 - Effects of salt-tolerant cotton on the development of Tobacco Budworm larvae.

Tobacco Budworm larvae were fed cotton callus that was either non-salt (NaCl) tolerant or tolerant to salt at 150 mM. Their developmental rates were compared to larvae on commercial diet. The mortality rate of the larvae on the 150 mM salt tolerant callus was 100%. The developmental rate for the larvae fed on salt-susceptible callus was less than the larvae fed on the commercial diet. The high mortality and low developmental rates in callus may be due to higher concentrations of antioxidant enzymes. These tests are being repeated with whole plants.

- 131 WATSON, LINDA E.¹ AND TIMOTHY M. EVANS². ¹Department of Botany, Miami University, Oxford, OH 45056 and ²Biology Department, Hope College, Holland, MI 49422. - Phylogeny of Tribe Anthemideae (Asteraceae), an analysis of nuclear and plastid sequences.

The Anthemideae is primarily an Old World tribe of approximately 109 genera and 1740 species, occurring mainly in the Northern Hemisphere. There are two major centers of diversity, including the Mediterranean Region and the Cape Province of South Africa. The tribe is widely recognized for its horticultural species that include the daisies, chrysanthemums, tansy, tarragon, chamomile, wormwood, and yarrow. Ecologically, the sagebrush species are dominant components of desert vegetation worldwide. Several taxonomic classifications have been proposed for this fairly large tribe, with the most comprehensive one based on a cladistic analysis of morphological characters. To test this classification and to further resolve systematic relationships, we sequenced the internal transcribed spacers (ITS) of nuclear ribosomal DNA and a 1200 bp portion of chloroplast gene *ndhF*, and subjected the datasets to phylogenetic analyses, both independently and combined. The resulting molecular phylogenies are incongruent with the morphological phylogeny, with little to no correspondence between clades and subtribes. However, the molecular phylogenies are strongly congruent with each other, despite being from different genomes. Furthermore, there is strong concordance with biogeography. Several South African clades are basal to the entire tribe, probably representing multiple,

relictual lineages. The Mediterranean clade is monophyletic and exhibits a pattern of recent and rapid radiation. Many species of this tribe have reduced floral structures associated with breeding system modifications, which have probably resulted in convergent evolution. This has undoubtedly contributed to an inaccurate interpretation of homology of morphological characters. This, combined with rapid radiation, has probably resulted in a poorly resolved and inaccurate estimation of phylogenetic relationships.

- 132 ALLISON, JAMES R. AND LORAN C. ANDERSON. Georgia Dept. of Natural Resources and Florida State University - *Sideroxylon duncanorum* (Sapotaceae), a new buckthorn from *Pinus palustris*-dominated communities of southeastern Georgia.

Sideroxylon duncanorum Allison & Anderson pro sp. is a soboliferous, thorny shrub, 1-4(10) dm high; pubescence of young twigs dense, that of the abaxial leaf surface, sepals, and ovary sparse to moderate; leaves oblanceolate, 1-3.5(5) cm long; fruit broadly ellipsoid, 1 cm long. Known from 13 counties in southeastern Georgia, it typically is found in dry, sandy *Pinus palustris*-dominated communities where fire is infrequent enough (or excluded long enough) to permit arborescent oaks (*Quercus margarettiae*, *Q. incana*, *Q. laevis*, *Q. marilandica*, and/or *Q. hemisphaerica*) to attain flowering size. The combination of low, colonial habit and largish, ellipsoid fruit distinguish it from other Southeastern buckthorns except the allopatric *S. rufohirtum* Herring & Judd [*Bumelia rufotomentosa* Small] of upper Peninsular Florida. Although very similar in appearance, the latter has a rustier pubescence, and SEM scans of abaxial leaf surfaces indicate that its peristomatal rims lack the concentric and radial striae common in *S. duncanorum*. The most significant distinctions, indicating full species status, are in the flowers, which exhibit a suite of quantitative differences, the most useful and compelling of which is relative staminode length: in *S. duncanorum* they reach only about half the height of the corolla lobes, while in sympatric species and in *S. rufohirtum*, they approximately equal the corolla lobes. The earliest collection known (1952) is *W. H. Duncan & J. W. Hardin 14622* [GA]. The specific epithet commemorates a lifetime of service to botany on the part of the first collector, Wilbur Duncan, and of his wife and work partner of more than 50 years, Marion.

- 133 DROZDA, NICHOLAS AND ZACK E. MURRELL. Department of Biology, Western Kentucky University, Bowling Green, KY 42101 - Variation and species boundaries in *Hexastylis heterophylla* (Ashe) Small.

Hexastylis heterophylla (Ashe) Small is a variable species with a range that extends from northern Alabama to West Virginia. The flowers of northern populations have been described as larger, with prominently flared calyces, often with the odor of sour milk, whereas, southern populations have been described with flowers that are smaller, not flared, and odorless. It has been suggested that the larger fragrant flowers are outcrossing and the smaller unscented flowers reproduce only by selfing. The present study reports preliminary data from morphological and molecular analyses of this variation. Specimens have been examined from A, GAM, GH, MO, NCU, TENN, US and USCH, as well as collections made throughout the range during Spring, 1996. Floral and vegetative characters were examined, including leaf blade length and width, lobe overlap at leaf base, and flower characters such as calyx length, diameter of calyx opening, calyx lobe length and width. The distribution of *H. heterophylla* is sympatric with *H. naniflora* in the south and *H. minor* in the north, and these three species are considered to be closely related. There is a possibility that the variation in *H. heterophylla* represents introgression with *H. naniflora* and *H. minor*. To test this hypothesis and to examine variability within the species, Randomly Amplified Polymorphic DNA (RAPDs) and DNA sequencing using the Internal Transcribed Spacer (ITS) region is underway. Preliminary results of both molecular and morphological methods indicate that *H. heterophylla* is highly variable, but appears distinct from both *H. naniflora* and *H. minor*.

- 134 ANDERS, CONSTANCE M. AND ZACK E. MURRELL. Department of Biology, Western Kentucky University, Bowling Green, KY 42101 - Genotypic and phenotypic variation in *Spiraea virginiana* Britton.

Spiraea virginiana is a federally listed rhizomatous shrub endemic to the southern Blue Ridge and Appalachian Plateau Provinces. The typical habitat of *S. virginiana* is along scoured sections of high gradient streams. Present evidence indicates that the species does not reproduce sexually. No viable seeds or seedlings have been found in the wild, suggesting that populations within drainages are products of vegetative reproduction, most probably occurring when rhizomes broken loose from upstream populations wash downstream to form new ramets. There is considerable confusion, therefore, regarding identification of individuals and thus no known mechanism for evaluating population size and structure. Phenotypic variation in *S. virginiana* was examined through a morphometric examination of leaf size and shape, using Morphosys to make 25 leaf measurements. These data were analyzed using Principal Components Analysis, to identify any morphological variation within and between drainages. We are currently examining genetic identity across the distribution using Randomly Amplified Polymorphic DNA (RAPDs), in an attempt to evaluate the genetic diversity. Genetic uniformity among the drainages would suggest that either extant populations are the ancestors of migrants that persisted through the glacial maximum in the watershed of the Gulf of Mexico, or

are the products of a severe bottleneck during the Hypsithermal Period. Genetic variation among the drainages would suggest that *S. virginiana* persisted through the last glacial maximum within the present day drainage systems, supporting Ogle's hypothesis that the present distribution of *S. virginiana* represents the remnants of a more widespread distribution in the past.

- 135 COX, PATRICIA B. University of Tennessee, Knoxville, TN 37996 - An overview of the subtribe Liatrinae (Eupatorieae; Compositae).

The Liatrinae, a subtribe within the tribe Eupatorieae, consist of six genera: *Carphephorus*, *Garberia*, *Hartwrightia*, *Liatris*, *Litrissa*, and *Trilisa*. The intergeneric taxonomy of *Carphephorus*, *Litrissa*, and *Trilisa* has been problematic. Some authors consider them to be distinct taxa whereas others combine all the species into one genus, *Carphephorus*. *Liatris*, the largest member of the subtribe includes approximately 42 species in two sections and 10 series. This genus has a widespread geographical distribution in eastern North America with ranges extending westward into Colorado and New Mexico and northward into Canada. The remaining five taxa have somewhat limited distributions in the southeastern United States. According to King and Robinson (1988), the subtribe Liatrinae is distinct from other members of the Eupatorieae by the presence of a basal rosette of leaves in all genera in at least the early stages of their life history. Micromorphological characters such as twin-hairs on the ten-ribbed achenes and a lack of a carpopodium on the achenes, also help to define this subtribe. Results of chloroplast DNA (cpDNA) restriction site analysis of members of the Eupatorieae show that the Liatrinae are closely related to a clade containing *Fleschmannia*, *Conoclinium*, and *Ageratum*. This supports King and Robinson's (1988) suggestion that the closest relatives to the Liatrinae were the subtribes Fleschmanniinae, Ayapanninae, and Alomiinae due to the presence of subimbricate involucre with persistent bracts.

- 136 PITTMAN, ALBERT B. and ANN DARR. South Carolina Heritage Trust Program - Two interesting Compositae collections from the sandhills of South Carolina.

While collecting in streamside seepage pocosins in the Fall Line Sandhills, two as yet unidentified specimens in the Asteraceae were observed. First collected was an *Aster* sp. with long falcate leaves and zigzag stems. This rhizomatous perennial is repent in habit and flowers well into November. The second composite specimen occupies similar habitat and maintains the same general habit but with the stems more clambering. These plants have very small heads with only five disk flowers and should be placed in the genus *Eupatorium*. The involucre bracts of the heads are hyaline-margined with their abaxial surfaces densely atomiferous-glandular. The taxonomy of both species will be proposed and discussed.

- 137 UNWIN, MATTHEW M., AND LINDA E. WATSON. Department of Botany, Miami University, Oxford, OH 45056 - Systematics of *Lachnocaulon* (Eriocaulaceae).

The Eriocaulaceae, as currently recognized, consists of 10 genera and over 1200 species. Distribution of the family is pantropical, with the majority of taxa occurring in South America. The only genus not represented in South America is *Lachnocaulon*, which primarily occurs in North America. *Lachnocaulon* is composed of seven perennial, herbaceous species, five of which are found in the southeastern United States and two in Cuba. Species of *Lachnocaulon* are generally found on sandy, acidic soils, in a wide range of habitats. *Lachnocaulon* is distinguished from the other genera primarily by the presence of finely branched root systems. The species of *Lachnocaulon* are recognized on the basis of such characters as scape pubescence, color of the involucre heads, and the presence or absence of secretions near the trichomes of the receptacular bractlets and perianth parts. The relationship of *Lachnocaulon* to the other genera of the Eriocaulaceae is not well understood, and little is known about interspecific relationships. We are examining both interspecific relationships and the affinities of *Lachnocaulon* to the genera occurring in the southern hemisphere. This should lead to a greater understanding of the evolution of this small temperate genus, and may provide insight into the evolution of a large tropical family. Towards this goal, we are sequencing the internal transcribed spacers (ITS) of nuclear ribosomal DNA in conjunction with the analysis of morphological based characters.

- 138 MOYNIHAN JEREMY AND LINDA E. WATSON. Dept. of Botany, Miami University, Oxford, Ohio 45056 - A phylogenetic study of *Neolaugeria* (Rubiaceae) using ITS sequence data.

Neolaugeria is a small genus endemic to the Greater and Lesser Antilles, composed of three species that are distributed in a linear fashion

throughout the islands. Two areas of sympatry occur on Cuba and Hispaniola. The three species are distinguished from one another on the basis of areolar patterns and laminar characteristics of the leaves. A systematic study of *Neolaugeria* is currently being conducted with the goal of constructing a phylogeny to resolve interspecific relationships, and to gain insight into the evolution of this island genus. The Internal Transcribed Spacers (ITS) of nuclear ribosomal DNA are being sequenced, and analyzed phylogenetically. Observations of habitat, substrate and elevational data support existing species boundaries within *Neolaugeria*.

- 139 SCOTT A. MYERS AND ZACK E. MURRELL. Department of Biology, Western Kentucky University, Bowling Green, KY 42101 - Evidence from nuclear rDNA for the phylogenetic placement of African dogwoods (*Cornus* subg. *Afrocrania*).

The genus *Cornus* (the dogwoods) contains 50 species that have been divided into nine subgenera. One of these species, *C. volkensii*, has been segregated into the subgenus *Afrocrania*. Previous studies combined morphological, anatomical, and chemical data to produce a hypothesis of evolutionary relationships that placed the subg. *Afrocrania* as a segregate lineage sister to the subg. *Cornus*, and placed the *Afrocrania*/*Cornus* lineage sister to the big bracted dogwoods. The subgenus *Afrocrania* has been examined morphologically, anatomically, and palynologically; however, it was not sequenced in Xiang's analysis of *rbcL* (chloroplast) sequence data, or in her analysis of the *matK* region of chloroplast DNA. Murrell's earlier analysis of the Internal Transcribed Spacer (ITS) region of nuclear ribosomal DNA included sequence data for *C. volkensii*, but these data were suspect due to inconsistencies with the sequence data for members of the subg. *Cornus*. We amplified both ITS regions from the subg. *Afrocrania* using the external primers 4 and 5 and the Polymerase Chain Reaction (PCR), and consistently obtained two distinct migrating bands approximately 750 bp in length. We cloned these amplified regions in an attempt to isolate these disparate bands for sequencing. Analysis of the sequence data suggests that the evolutionary origin of the African dogwood was not with the cornelian cherries, but was basal to the red-fruited clade of dwarf dogwoods, cornelian cherries and big bracted dogwoods; however, analysis of these data may be complicated by the problem of long branch attraction. These results suggests a need to re-examine fruit development and inflorescence structure in subg. *Afrocrania* and *Cornus*.

- 140 McMillan, Patrick D., and Richard D. Porcher - *Arnoglossum* sp. 1 = *Mesadenia elliotii* Harper in South Carolina and the Southeast.

During field investigations of the Savannah River Site in Aiken and Barnwell counties, South Carolina, Richard D. Porcher collected an anomalous species of *Arnoglossum* which was tentatively identified as *Arnoglossum sulcatum*. A specimen was sent to Patrick D. McMillan who then identified the plant with a currently unrecognized species which has been described as *Mesadenia elliotii* by Harper in 1905. There is currently only a paucity of confusing and contradictory literature available on this species, which has never received an accurate and exhaustive species description and accurate comment on its ecology and habitat. This species has been lumped under the name *Arnoglossum ovatum* by recent authors in floras covering the southeast, and appears in Small's *Manual of the Southeastern Flora* under the Harper epithet. Recent field and herbarium studies by the authors have elucidated this taxon and shown that the morphology, ecology, and natural range tends to be distinct from *Arnoglossum ovatum*. This discovery of this rare taxon in South Carolina is also the first such report for the state.

- 141 THOMAS, R. DALE¹, ERIC SUNDELL², CARL AMASON³, AND CHRIS DOFFITT¹
¹Dept. Biology, Northeast Louisiana University, ²Dept. Natural Sciences, University of Arkansas, Monticello, ³P.O. Box 164, Calion, AR.
A Checklist of the vascular plants of Ashley, Bradley, Calhoun, Drew, and Union counties of southern Arkansas.

A survey of the vascular plants known to be from five south Arkansas counties was made. The checklist includes data from two thesis projects finished at Northeast Louisiana University (Bradley--Sherrie Leslie and Ashley--Susan Hooks). It also includes data from years of collections made from Drew County by teachers and students at University of Arkansas at Monticello. Recent projects by the authors have emphasized collections from Union and Calhoun counties. The bulk of the information is from collections in the herbaria of Northeast Louisiana University and Univ.

of Arkansas at Monticello. Smith's Atlas of Arkansas Plants as well as literature was used in making the list. A copy of the list will be available at the presentation.

- 142 ALLEN, CHARLES¹ AND MALCOLM VIDRINE². ¹Northeast Louisiana University, Monroe, LA 71209 and ²LSU at Eunice, Eunice, LA 70535-
Flora of Cajun Prairie in southwestern Louisiana.

Cajun Prairie is an threatened element of Coastal Prairie located in southwestern Louisiana and persisting mainly along railroad right of ways. The flora consists of more than 500 taxa with the larger families including the Poaceae, Asteraceae, and Fabaceae. Data on frequency of occurrence of taxa from ten remnant strips are reported.

- 143 HAYNES, ROBERT R. AND STEVEN L. GINZBARG. Department of Biological Sciences, The University of Alabama, Tuscaloosa, AL 35487-0345 - Optimizing Label Data Entry for Herbarium Data Bases

There exist in the 100 plus herbaria of the Southeastern United States approximately six million specimens, and in herbaria of the entire United States probably in excess of 60 million specimens. These existing specimens represent a tremendous amount of knowledge about plants that is mostly not readily available because the data are not in a format that can be easily and quickly queried. This project describes a rapid and inexpensive method of data acquisition and data entry. An image of all written data from each of approximately 50,000 specimens from the University of Alabama Herbarium was prepared using a Kodak DCS 420c Digital Camera, and the images archived on 74-minute CDs. The images were transferred via the Internet to India for data entry. The keyed data were sent to Tuscaloosa via FTP over the Internet where it is being made available of searching over the Internet. Total time required per specimen for UNA personnel averages about 1 minute, which includes obtaining the specimen from the shelves, taking the image, any image manipulation required, and sending the image for data keying. Each image costs about \$0.30 for data keying.

- 144 Rogers, Charles P. and Cline, George R. Dept. of Biology, Jacksonville State University, Jacksonville, AL 36265 -Anuran breeding phenology at a northeast Alabama pond.

Frogs appear to be vanishing at an alarming rate. Studies of anuran populations in the south have been few resulting in a lack of population data for southern anurans. This population data is important in determining trends over time. Since anurans are most often encountered at their breeding sites, this is where data is most often collected. Breeding phenology establishes at what times in the year a given species will breed, based on the production of an advertisement call. As well as breeding phenology, population size estimates using the Wisconsin call index were collected. These data serve as excellent baseline data and will allow for future use in determining trends at a given site. Ten species; *Acris crepitans*, *Gastrophryne carolinensis*, *Hyla chrysoscelis*, *H. cinerea*, *H. gratiosa*, *Pseudacris crucifer*, *P. triseriata*, *Rana catesbeiana*, *R. clamitans*, and *R. utricularia* were found to be using the site as a breeding pond. Trends in the calling activity of these species will be discussed.

- 145 OLIVER, AUTUMN AND GEORGE CLINE. Jacksonville State University - Preliminary Morphometric Analysis of Shape in Alabama Turtles.

Modern evolutionary biologists accept the premise that the morphology and ecology of an organism are subject to selective pressures. The interaction of these suites of characters can be seen in the biology of turtles. In general, terrestrial turtles rely on the shell to protect them from most predators. Aquatic turtles tend to rely on speed to avoid predators. Thus, natural selection should favor shell shapes that compliment these ecologies. We measured carapace length, carapace width and carapace height for seven Alabama turtles species. Regression analysis revealed allometric growth differences among these species. Principle Components Analysis will be used to compare turtle shapes, and search for groups among the data. These data will be discussed in view of the ecologies of each species.

- 146 LAPP, KEVIN AND R. WAYNE VAN DEVENDER. Dept. of Biology, Appalachian State University, Boone, NC 28608 - Natural History and Population Characteristics of the salamander *Plethodon wehrlei* on Saddle Mountain in Surry County, North Carolina.

Plethodon wehrlei, a terrestrial plethodontid salamander, reaches the southern extent of its range in northern North Carolina. This salamander has been found at Saddle Mountain (on the border of Surry and Alleghany counties) and in Stokes County in the vicinity of Hanging Rock State Park. A mark-and-recapture study was performed on two transects located on eastern and southern slopes of Saddle Mountain. These transects were monitored from July 1996 through November 1997. A total of 116 animals were marked and of these 14 individuals were recaptured on one transect while 12 animals were marked and one recaptured on the other transect. Surface activity in this species followed a seasonal pattern: winter activity was sporadic and dependent on warmer temperatures, spring and fall were periods of peak occurrence, and only juveniles < 30 mm SVL were active in summer. Recapture data showed that this species moved an average of 5.8 ± 3.24 m between captures. A Schumacher-Eschmeyer index was used to provide a density estimate of 573 ± 70.6 individuals/ 1500m^2 or 1 individual/ 2.6m^2 .

- 147 LANG, CYNTHIA AND ROBERT G. JAEGER. The University of Southwestern Louisiana - Co-defense of Territories by Male-Female Pairs in the Red-backed Salamander (*Plethodon cinereus*).

Our study addressed the question: do red-backed salamanders co-defend territories as male-female pairs? Our main hypothesis was that a male and female pair will be significantly more effective at removing an intruder from a territory than either member of the pair can do separately. During the fall courtship season and the summer non-courtship season in Virginia we collected male-female pairs, single males and single females. The randomized treatments consisted of the male-female pair confronting (1) a male intruder and (2) a female intruder; the male resident alone confronting (3) a male intruder and (4) a female intruder; and the female resident alone confronting (5) a male intruder and (6) a female intruder. Preliminary data from these tests show that the intruding males and females did not spend significantly more time on a territory defended by a male-female pair versus a territory defended by a single salamander (male or female) from the pair. However, males when together with the paired females spent significantly more time in the threat posture than females in the pair towards intruding males. Females when together with the paired males spent significantly more time in the threat posture than males in the pair toward intruding females. We suggest that if co-defense of territories is not occurring, at least mate guarding is taking place.

- 148 MOSER, JOHN G. JR., JAMES D. COUCH, AND GEORGE R. CLINE. Jacksonville State University - Breeding phenology of two ponds in Northeast Alabama.

Breeding phenologies were studied at two northeast Alabama ponds from February to June of 1997. Site A was a permanent stock pond for cattle in an open pasture with little vegetative cover. Site B is a stock pond for horses nestled against a steep hillside to the south and dense wooded area to the east with heavy ground vegetation. Both ponds flood over into the pastures during spring and fall forming shallow ephemeral breeding areas for frogs. Frog calls were recorded and evaluated using the Wisconsin Calling Index (0, 1, 2, 3). Relative humidity, air and water temperatures, and general weather conditions were recorded at the same time. Calling intensity at the onset of calling differed among conspecifics at the two sites. These differences might be attributed to physical characteristics at each site. Overnight observations indicated a clear correlation of call intensities to air temperatures. Although air temperatures dropped considerably, the long-term breeder *Pseudacris crucifer* continued to call to near 0° Celsius. Explosive breeders such as *Bufo americanus* were more attuned to breeding during storm events, and calling levels of ranids were consistently low at both sites. Correlation of data between the sites indicates that activity of these organisms may be closely related to changes in barometric pressure.

- 149 ADAMS, JASON R. AND GEORGE R. CLINE. Population trend analysis using calling indices in Northeastern Alabama wetlands.

Studies of reproductive habits of anurans in the United States have shown that some general patterns exist in the timing of breeding at specific sites (Wiest, 1981). Typical sites include temporal pools, ponds,

lakes, streams, and other types of wetlands. Phenological studies of various durations have been reported (i.e. Goin and Goin 1953; Blair 1961; Murphy 1963; Rubin 1963) but little quantitative work has been conducted in the southeastern United States. Recent concerns about amphibian population declines have prompted the development of standardized methods for analyzing population size using call chorus indices. We used the Wisconsin Calling Index (0,1,2,3) for monitoring chorus intensity at 3 wetlands on Fort McClellan in Northeast Alabama. Calling indices are discussed for anuran species. Breeding phenologies varied in starting dates, but the patterns observed were similar at all sites.

- 150 ANDREWS, KENNETH D. AND JOHN L. CARR. Dept. Biology, Glendale Community College, Glendale, AZ 85302 and Dept. Biology, Northeast Louisiana University, Monroe, LA 71209 - Variation in the scleral ossicles of cryptodiran turtles.

Among tetrapods, scleral ossicles form a ring of small bony plates in the eyes of *Sphenodon*, lizards, turtles, and birds. The number of ossicles and their pattern of overlap have been used as taxonomic characters for lizards and birds; however, the ossicles of turtles have been considered too variable to be phylogenetically informative. We undertook a more comprehensive survey to assess levels of variability in scleral ossicles and their potential utility as taxonomic characters among chelonians. Ossicles in 432 eyes from 73 species representing nine out of 10 cryptodiran families were cleared and stained. The ossicles were counted and the pattern of ossicle overlap in the ring for each eye recorded. Contralateral symmetry, and extent of intraspecific and interspecific variation were analyzed. Number of ossicles ranged from 7 to 14 per eye. The most common numbers of ossicles were 10 (39%) and 11 (35%). There was a high degree of contralateral symmetry in the number of ossicles present. Within a species, the extent of contralateral symmetry in overlap pattern ranged from 38.5% to 100%. For the most common numbers of ossicles, overlap patterns were predominated by one or two very common patterns. Although number of ossicles alone may be useful in distinguishing some closely related species, it has limited use at higher taxonomic levels. The overlap patterns are very conservative and therefore not very phylogenetically informative.

- 151 AKIN, JONATHAN A., AND GREG S. SONNIER. Dept. of Biology, University of Southwestern Louisiana, Lafayette, LA 70504 - Mother-offspring interactions in the ground skink, *Scincella lateralis*.

Parental care is relatively rare in reptiles and cannibalism of offspring occurs in some taxa. Yet, young often remain near their parents with little, if any, dispersal. Using hatchling *Scincella lateralis* reared from eggs laid by known mothers, we examined the responses of female ground skinks ($n = 5$) to each of three testing conditions: her own offspring, another female's offspring, and a surrogate control. In addition, we observed the responses of individual hatchlings to either their own ($n = 5$) or a different ($n = 5$) mother. While the responses of mothers were not significantly different among treatments, the hatchlings did associate more closely with their own mother than with a different female. Furthermore, a single female cannibalized both her own and another female's offspring during testing. These preliminary data suggest that kin recognition of offspring by mothers may not occur in this species, but that hatchlings may exhibit an association preference for their own mothers versus different females.

- 152 JULIAN, JAMES AND JAMES HOWARD. Frostburg State University - Translocation of amphibians into mitigated and existing wetlands - a review of a new protocol.

Previous amphibian relocation, repatriation, and translocation programs have proven most successful when introducing individuals in early developmental stages. In hopes of re-establishing populations of rare amphibian species into parts of their traditional range, we have developed the following protocol and will test it in over the next 2 years. We will introduce egg masses of rare amphibian species into artificial ponds in a small mitigated wetland area and an adjacent existing wetland at Rocky Gap State Park, MD. These ponds are approximately 4.3 x 4.3 m and vary in depth so that shallower ponds will facilitate small, rare anuran species by excluding larger, more common species with longer developmental stages. To monitor migration, all ponds have been encircled by drift fencing aligned with both pitfall traps and small funnel traps. Introduced egg masses will be monitored by recording the percent of individuals that reach the tadpole stage, and larval success will be monitored by tracking tadpole survivorship via weekly population estimates using a quadrat box sampling technique. Metamorphosed individuals caught in traps while dispersing from the ponds will be marked with a toe-clipping scheme to determine if they return to breed in subsequent seasons.

- 153 STEVENS, BENJAMIN W., AARON D. ATWOOD, AND JAY A. YODER. Department of Biology, The Illinois College, Jacksonville, IL 62650 - Squalene: A naturally-occurring skin lipid that serves as an attractant to ticks

Squalene [of unestablished function] is the dominant component of a secretion released by ticks. Emission of this secretion attracts other ticks, resulting in the formation of clusters. Feeding ticks release this secretion to recruit other ticks to the host (aggregation-attachment pheromone). Clustering off-host protects ticks against predators such as ants (clustering 'alarm' pheromone), because the secretion functions parsimoniously as a defense secretion (allomone). This is the first demonstration that squalene acts as an attractant to the lone star tick, *Amblyomma americanum*, and American dog tick, *Dermacentor variabilis*. Attraction to squalene is greater (>60% of ticks vs. 30-40%) than other single chemicals known to attract ticks (methyl salicylate, nonanoic acid and *o*-nitrophenol = active ingredients of aggregation-attachment pheromones); attraction does not appear to be restricted to developmental stages or species. Leg removal studies indicate that squalene is detected by the first pair of legs. Because squalene is a major lipid present on the skin and in the blood of many mammals, this implies that squalene contributes in part with host body temperature and CO₂ in attracting ticks to hosts. These results offer the potential for tick control using pheromone traps baited with a natural product.

- 154 RIVERA, RICHARD, MATHIUS J. SEDIVEC, WILLIAM E. DOBSON, AND MARK E. VENABLE. Department of Biology, Appalachian State University, Boone, NC 28608 - The effects of 1,1,3-Tricyano-2-amino-1-propene (Triap) on arm regeneration in *Microphidopholis gracillima*

Triap is a low molecular weight molecule that causes some of the same neurotrophic responses as nerve growth factor (NGF). Both compounds enhance neurite outgrowth, increase cellular hypertrophy and cell-substratum adhesion, and stimulate choline acetyltransferase and tyrosine hydroxylase in PC 12 cells. Antibodies to NGF and its receptor do not inhibit Triap's effects. Triap potentiates ornithine decarboxylase activity only in the presence of NGF. While the mechanisms of Triap and NGF remain unknown, evidence supports the idea that these neurotrophic factors may share several steps in their pathways. No research with Triap to date has been performed using invertebrate organisms. *Microphidopholis gracillima* (brittlestar) is a marine organism with tremendous regenerative capabilities. Brittlestars can autotomize arm segments, then rapidly replace the lost parts. The purpose of this study is to determine if Triap affects the rate of arm regeneration in brittlestars. Brittlestars are kept in clear plastic bowls (5/bowl, 20 bowls) of natural seawater at a predetermined concentration of Triap at which maximal arm regeneration occurs. Triap's effects are quantified by comparing lengths of regenerating arms with and without lesioned radial nerves. Measurements are made every other day for 15 days. Light microscopic techniques are employed to observe morphology. We hope that Triap may eventually be used as a therapeutic agent for individuals with neurodegenerative diseases and spinal cord injuries.

- 155 CASH, W.B. and R.L. HOLBERTON. University of Mississippi - Corticosterone and behavior in the freshwater turtle, *Trachemys scripta elegans*

We are investigating behavioral and endocrine responses to changes in habitat quality in the red-eared slider, a turtle commonly found in habitats where resources may be ephemeral. Specifically, we are interested in corticosterone, a hormone associated with several behavioral and physiological responses believed to be beneficial during periods of reduced food availability and/or increased energetic demand. We have demonstrated that free-living red-eared sliders, like many other species, mobilize corticosterone in response to acute stress [$n=16$, $P=0.001$]. In an experimental study, elevated levels of exogenous corticosterone, as administered with Silastic implants and validated by higher plasma levels of hormone, resulted in a significant increase in caged locomotor activity ($n=15$) while a control group with empty implants showed no such change ($n=15$). These results support the hypothesis that an increase in corticosterone in response to periods of perturbation can facilitate an increase in local prey encounter rate or eventual dispersal out of a poor habitat through the hormone's effect on locomotor activity. Such investigations integrating behavioral and endocrine responses to changes in habitat quality can lead to better understanding of constraints on survivorship and reproduction in animals living in stochastic habitats.

- 156 HOOKER, BEN AND MATHIUS J. SEDIVEC. Department of Biology, Appalachian State University, Boone, NC 28608 -- Effects of 1,1,3-tricyano-2-amino-1-propene (Triap) on the regeneration of crushed sciatic nerve in adult rats

Nerve growth factor (NGF) has been identified as a diffusable molecule involved in the natural regeneration of injured nerves. Following a period of degeneration after injury, NGF and NGF receptor mRNA expression in Schwann cells increases, the result of interleukin-1 released by macrophages infiltrating the lesion site. Schwann cells in the lesion site respond by releasing NGF, leading to local increases in NGF concentrations that act to attract regenerating axons. Only axons responsive to NGF will survive once they contact Schwann cells expressing NGF. Triap is a small organic molecule that was shown to mimic and potentiate the effects of NGF when tested in cell culture. Triap also increased the rate of recovery in dogs that had undergone an experimental sciatic nerve crush. This research is designed to examine the effects of Triap on the rate of recovery in rats that had undergone an experimental sciatic nerve crush. Tests of function, response to sensory stimuli, nerve physiology, and basic histology were conducted on three groups: sham-operated control (N=7), crush (N=11), and crush + Triap (N=11). The sciatic functional index (SFI) was used to assess the level of function each subject had regained following surgery. A modified pinch test was used to measure regeneration of sensory axons. Conduction velocity of each nerve was compared to measure differences in nerve performance. Light-level histology was performed to detect gross morphological differences between groups.

- 157 SKELTON, C.E. and D.A. ETNIER. University of Tennessee, Knoxville, TN - *Etheostoma denoncourtii* revisited.

The golden darter (*Etheostoma denoncourtii*) was recently described from the upper Tennessee River system as distinct from the Tippecanoe darter (*E. tippecanoe*). *Etheostoma tippecanoe* occurs in widely scattered populations in the Ohio and Cumberland River drainages. In their description, Stauffer and van Snik (Copeia 1997(1):116) did not evaluate specimens from the Duck River system, which lies between the upper Tennessee and the Ohio/Cumberland drainage. A study was conducted in order to evaluate the taxonomic status of the Duck River population. Sheared principal components analysis of 27 morphometric variables separates the Duck River population from *E. tippecanoe* and *E. denoncourtii*. The Duck River population differs by having a shorter anal and soft dorsal fin base length and a wider body. Additionally, the Duck River population differs from *E. denoncourtii* by usually having fewer dorsal spines and from both *tippecanoe* and *denoncourtii* by having fewer dorsal soft rays and fewer pored lateral line scales. Our analyses indicate that differences between the Duck River population and both *E. tippecanoe* and *E. denoncourtii* are greater than the differences between the latter two. We feel that considering this complex as a single, variable species is reasonable.

158

- KINZIGER, ANDREW P.¹, DAVID A. NEELY², AND RICHARD L. RAESLY¹. ¹Dept. of Biology, Frostburg State University, Frostburg, MD 21532 and ²Dept. of Biological Science, University of Alabama, Tuscaloosa, AL 35487 - A new species of sculpin (Cottidae: *Cottus*) from the mid-Atlantic region of the Eastern United States.

The Blue Ridge form of *Cottus bairdi* is elevated to species status. This new species is distributed in six mid-Atlantic slope drainages (Susquehanna, Patapsco, Potomac, Rappahannock, James and Roanoke) and a coastal plain drainage (Nanticoke). It is distinguished from the closely related *C. bairdi* by the absence of a basicaudal notch and the possession (modally) of 13-14 pectoral fin rays. Although *C. bairdi* and the new species are largely allopatric, syntopic populations occur in Wills Creek, Potomac River drainage, as a result of stream piracy. Allozyme and meristic data from Wills Creek indicate incomplete reproductive isolation with a narrow zone of hybridization occurring between the new species and *C. bairdi*. Using allozyme data, PAUP and FREQPARS are employed to generate phylogenetic hypotheses. Evidence is also presented that suggests Nanticoke River populations should be recognized as distinct species.

- 159 CAGE, BRYAN AND FRANK PEZOLD. Northeast Louisiana University - A review of the spinycheek sleepers (Teleostei: Eleotris) of the eastern Pacific Basin.

As a part of a review of the cosmopolitan gobioid genus *Eleotris*, we examined specimens representative of the genus from continental eastern Pacific (Western Hemisphere) drainages from Mexico to Ecuador and from Cocos Island, Isla Gorgona, Colombia and the Galapagos Islands. Nineteen morphometric and six meristic characters and cephalic lateralis patterns were studied. Three nominal species, *Eleotris picta* Kner and Steindachner, *Eleotris tubularis* Heller and Snodgrass, and *Eleotris tecta* Bussing, are distinguishable by scale counts (scale size) and cephalic lateralis features.

- 160 LAYMAN, STEVEN R. CH2M HILL, 115 Perimeter Center Place, Suite 700, Atlanta, GA 30346 - Species diversity and phylogenetic relationships of the subgenus *Doration* (Percidae: *Etheostoma*).

Evolutionary diversity and phylogenetic relationships of darters of the subgenus *Doration* were investigated using geographic variation in morphology, male breeding colors, and allozyme characters. A revision of the subgenus is presented, with redescrptions of *Etheostoma stigmaeum*, *E. jessiae*, and *E. meadiae*, and descriptions of six new species. New species are recognized from the Caney Fork River system, the Duck River system, the Cumberland River drainage, the Green River drainage, the middle Arkansas and upper White river drainages of the Ozark Highlands, and the upper Caddo and Ouachita rivers of the Ouachita Highlands. Five of the new species are recognized from nominal *E. stigmaeum*, as conceived by Howell (1968). *Etheostoma stigmaeum* remains the most widely distributed species but is newly restricted to Mobile Basin and other Gulf Coast systems, the Mississippi Embayment and highland tributaries thereof in northeastern Arkansas and southeastern Missouri, and Bear Creek of the Tennessee drainage. Phylogenetic analyses support the monophyly of *Doration* but suggest that *E. stigmaeum*, as newly restricted, is paraphyletic and may still represent more than one species.

- 161 NEELY, DAVID A., PHILLIP M. HARRIS, AND RICHARD L. MAYDEN. Biodiversity and Systematics, Box 870345, The University of Alabama, Tuscaloosa, AL 35487-0345. Morphological differentiation in populations of the frecklebelly madtom, *Noturus munitus*

The upper Coosa River drainage poses a perplexing biogeographic problem: it harbors isolated populations of many species of fishes otherwise found only below the Fall Line. Over 17 species have isolates in the Etowah, Conasauga, and Coosawattee drainages. The already recognized high degree of endemism in the drainage (*Percina antesella*, *P. jenkinsi*, *Etheostoma etowahae*, *E. scotti*, etc.) suggests the possibility of cryptic species in other, more "widespread" taxa. We examined morphometric and meristic variation across the range of the Federally Threatened frecklebelly madtom, *Noturus munitus*. Preliminary evidence indicates the population in the Etowah River system possesses a unique suite of morphological characters, including differences in shape and pigmentation, when compared with populations from the Pearl, Cahaba, and Tombigbee Rivers. We are in the process of analyzing genetic variation within the species to determine whether the same pattern exists.

- 162 PILLER, KYLE R. AND HENRY L. BART JR. Tulane University Museum of Natural History, Belle Chasse, LA 70037 -Morphological variation of the redfin darter, *Etheostoma whipplei*, with comments on the status of the subspecific populations.

The redfin darter, *Etheostoma whipplei*, has been the subject of several systematic studies over the past fifty years. At the present time, two subspecies are recognized. *Etheostoma whipplei whipplei* occurs in the Arkansas and White River drainages above the Fall line and *E. w. artesiae* occurs in the Gulf Coast drainages in the Mobile Bay system, lower tributaries of the Mississippi River, and in the Neches, Red, and Ouachita Rivers of Louisiana and Texas. We undertook a morphological study of geographic variation in *E. whipplei*. Museum specimens were examined for geographic variation of meristics, pigmentation, and morphometry. Meristic counts of *E. w. whipplei* were significantly higher than those for *E. w. artesiae*. We found no morphological evidence of intergradation between upland populations in the Arkansas and White Rivers and populations in the rest of the species range. We recommend that all populations currently recognized as *E. w. artesiae* be elevated to full specific status. Future work will focus on the distinctiveness of populations of *E. artesiae* in the upland portions of the Mobile Basin and on the disjunct population in the Chattahoochee River system.

- 163 RICHARDSON, LINDA R. AND JOHN R. GOLD. Center for Biosystematics and Biodiversity, Texas A&M University, College Station, Texas 77843-2258 - Evolution of the *Cyprinella lutrensis* species-group. IV - Geographic variation in the mitochondrial DNA of the red shiner (*Cyprinella lutrensis*). evidence for pre-Pleistocene connection of western Gulf Coastal Plain drainages.

Mitochondrial (mt)DNA analysis was utilized to determine if significant phylogeographic structure occurs in *Cyprinella lutrensis*. Parsimony analysis based on restriction-site variation of mtDNA haplotypes identified a clade of *C. lutrensis* mtDNA genomes distinct from all other *C. lutrensis*

surveyed. Individuals possessing the mtDNA genomes which comprise this clade were found in the middle to upper reaches of four river drainages in the western portion of the red shiners range (i.e., Canadian, Red, Trinity, and Pecos rivers). The geographic distribution of this clade is discussed in the context of a biogeographic hypothesis of pre-Pleistocene drainages in the western Gulf Coastal Plain.

- 164 DURRANT, GARY EDWARD. Department of Biology, Jacksonville State University, Jacksonville, AL 36265. A new hypothesis for swimming locomotion in tunas and cetaceans: does the caudal fin function as a centrifugal pump?

Tunas, jacks, and cetaceans have crescent-shaped caudal fins with high aspect ratios ($\text{height}^2 / \text{length}$). The conventional hypothesis of the physiology of these fins is that they function like bird wings, or the front flippers of sea turtles. As a sea turtle swings its front flippers in a downward direction, the fluid flow over the upper, curved surface of the flipper is faster than the fluid flow over the flat, lower surface of the flipper, thus setting up induced forces through the Bernoulli Effect. The Bernoulli Effect sets up two component force vectors in the turtle's body, one component lifts the turtle in an upward direction (which is wasted in a marine animal), and the other component pushes the animal in the forward direction (providing useful thrust). There is a paradox here in that a "wing" propulsor forms vortices at the tips, while MIT's "ROBOTUNA" experiments prove that tunas form vortices along their flanks. These flank vortices are accelerated by the caudal fin as it passes by, thus causing forward thrust. Another paradox is that the cross-sections of the tuna and cetacean fins are often bent in a "backwards" direction, with the concave surface on the retreating side, and the convex surface on the advancing side of the fin. One way around this paradox is to consider the tuna caudal fin as a single vane of a centrifugal pump. In this hypothesis, the posterior body of the animal, and its caudal peduncle, function together as a long lever arm, and the caudal fin (attached to the lever arm) functions as a centrifugal vane (or launcher), thus accelerating the flank vortices, and creating thrust in a forward direction. This new hypothesis is promising because the hydrodynamics of centrifugal pumps is compatible with both the "backwards" shape of tuna fins, and the formation of vortices along the trailing edges of the centrifugal vanes.

- 165 KUHAJDA, BERNARD R., DAVID A. NEELY, AND RICHARD L. MAYDEN. Dept. Biological Sciences, University of Alabama, Tuscaloosa, AL 35487 - Do Ohio lampreys (*Ichthyomyzon bdellium*) inhabit Alabama waters?

Current distributional accounts for the Ohio lamprey, *Ichthyomyzon bdellium*, include the middle Tennessee River Drainage in northern Alabama. Recent collection efforts have produced only chestnut lampreys, *I. castaneus*, which vary in color from olive-green to silver grey. We believe this wide variation in color has led to the mis-identification of *I. castaneus* as *I. bdellium*. Based on the examination of oral disc size, number of myomeres, shape of transverse lingual lamina (TLL), and number of cusps on the TLL, *I. bdellium* is restricted in the Tennessee River Drainage to upstream of Waldens Gap, and does not occur in Alabama. *Ichthyomyzon castaneus* has significantly more cusps (mean = 40.3) than *I. bdellium* (mean = 26.4), and overlap is minimal. A plot of the number of cusp versus myomeres gives complete separation between the two species.

- 166 BAXTER, JOHN T., JR. University of Tennessee, Knoxville - The fish fauna of the Upper Cumberland River drainage in Tennessee.

An ichthyofaunal survey of the upper Cumberland river drainage in Scott, Campbell, and Claiborne counties, Tennessee was conducted from May 1995-October 1997. This drainage lies on the Cumberland Plateau in northeastern Tennessee and the fish fauna has been impacted by extensive coal mining activity in the region. Data from a total of 109 localities are included. Past collections by other investigators are also included to generate distribution maps. This study reveals a relatively rich upper Cumberland river fish fauna. Of the 58 species that potentially occur in the drainage, 44 were substantiated by collection records. Present in the drainage are five listed species; *Phoxinus cumberlandensis*, *Ericymba buccata*, *Notropis rubellus rubellus*, *Etheostoma baileyi*, and *Etheostoma sagitta sagitta*. This study reveals healthy populations of four of these listed species in the state. The fifth species, *Ericymba buccata*, is threatened with extirpation from the state. Occurrence and distribution of each species found in the drainage is discussed.

- 167 OUCHLEY, KELBY. U. S. Fish & Wildlife Service. Farmerville, LA - Bottomland hardwood restoration in the lower Mississippi River Valley - a practitioner's perspective.

Over the last decade considerable effort and millions of dollars have been spent bottomland hardwood restoration in the Lower Mississippi River Valley (LMRV). During this period, techniques have been

developed and refined and short-term successes have been reported -- that is, if restoration success is measured only in terms of oak seedling survival. There is evidence that much of the restoration work to date should be considered "reforestation" instead of actual "restoration" of the critical components of a bottomland hardwood ecosystem. During the next decade, we will be facing daunting restoration challenges in the LMRV with shrinking resources. It is therefore imperative that we re-evaluate our restoration efforts from an ecosystem context in order to build on knowledge from past accomplishments and failures.

- 168 RIBBECK, KENNY AND LARRY SAVAGE. Louisiana Department of Wildlife and Fisheries - Restoration of bottomland hardwoods: a 30 year perspective

The Louisiana Department of Wildlife and Fisheries has converted 8,100 ha of marginal cropland to bottomland hardwood forest in an effort to enlarge and connect existing state-owned Wildlife Management Areas. Producing a functional wetland forest that supports a full array of native and migratory wildlife species is the ultimate restoration goal. The first restoration project initiated in 1967 resulted in a heavily stocked (>1,482 seedlings/ha) oak monoculture with little natural species diversity. In a subsequent large-scale restoration project started in 1985, oaks and hickories were planted at low to moderate stocking rates (494-741 seedlings/ha) to allow for the natural invasion of wind, water and animal borne species. Additionally, oaks not historically found on this site were planted to enhance species diversity. A 10-year evaluation of this approach revealed a limited, slow invasion of native light-seeded species and mortality of non-historic oaks. Current reforestation strategy involves planting a combination of heavy and light-seeded species (1,077 seedlings/ha) to ensure a natural stand composition limited strictly to the historic occupants of the site. Factors impacting the development of this restoration process will be discussed, including: seed predation, seed availability, site quality, site/species relations, planting techniques, man-made alterations of sites, and evaluation of seedling survival.

- 169 DEWEY, JANET C., STEPHEN H. SCHOLNHOLTZ, JOHN A. STANTURF, DAVID E. PETTRY AND EDWARD W. MAURITZ. Mississippi State University and USFS - Along the path to recovery: soil as an indicator of bottomland hardwood forest restoration.

Bottomland hardwood (BLH) reforestation programs in the Lower Miss. Alluvial Valley (LMAV) are being implemented on thousands of ha of marginal, frequently-flooded farmland through federal, state, and private efforts. Restoration status of these lands is measured by tree survival; the role of soil properties as an indicator of recovery in BLH forests is rarely considered. The dominant soil in the LMAV, Sharkey vertic haplaquepts, was compared in three replications of a chronosequence of BLH restoration sites: currently farmed soybean fields, 3-5-yr-old Nuttall oak (*Quercus nuttallii*) plantings on former soybean fields, 10-15-yr-old Nuttall oak plantings on former soybean fields, and reference BLH forests dominated by Nuttall oak. Soil properties evaluated at depths to 75 cm include pH, total C and N, extractable P, exchangeable Ca, K, Mg and Na, bulk density, saturated hydraulic conductivity and total porosity. Reforestation has changed soil properties at depths <25 cm. Soil N and C, saturated hydraulic conductivity and porosity increased with age, whereas bulk density and pH decreased. There were no treatment effects below depths of 25 cm, or in exchangeable cations at any depth. Observed changes in soil properties indicate that tree-reestablishment on Sharkey soils of the LMAV initiates soil restoration following row-crop agriculture, and that soil characteristics are useful indicators for restoration assessment.

- 170 SCHWEITZER, CALLIE JO. USDA Forest Service, Center for Bottomland Hardwoods Research, Stoneville, MS 38776 - Measuring success in bottomland hardwood forest restoration.

Determining the success of bottomland hardwood forest restoration is imperative to learning about the processes and outcomes and to making appropriate adjustments. The major obstacle in determining how to measure the success of restoration activities is that, from the get-go, the project goals are often not clearly defined. Thus, conclusions on success are then often based on intuition or impressions rather than on quantitative data. There are some concrete data collection tactics, when used in conjunction with clearly defined goals and criteria for success, which can help resource managers get a handle on the status of their efforts. Virtually all success criteria designated for restoration efforts involve a study only of physiognomy of restored vegetation. Monitoring methods must be set up so data can be collected for floral, edaphic and hydrologic factors. Monitoring must be collected consistently on difficult sites and over time. Clear definitions and boundaries must be agreed upon for the different spatial and ecological dimensions involved, and these must be sensitive to changes. There needs to be a standardization in resource evaluation procedures, applicable over a wide range of landscape types. And, the interruptions that are inevitable due to budget and time constraints

must be considered. Objectives are required for both management and monitoring in order to enable measurement of success or failure. An understanding of ecological principles and how bottomland hardwood forests develop and function will also aid the approach of developing success criteria.

- 171 STATEN, MIKE. Anderson-Tully Company - Integrating bird habitat in industrial forest management.

Habitat diversity for breeding bird species can be maintained in a managed forest through the use of uneven-aged and even-aged silvicultural systems. Short and long rotation lengths within the forest, as well as a variety of tree species will increase forest diversity. Multiple silvicultural entries into the forest allows for development of layers and vertical structure necessary for a variety of bird species. Within a landscape scale, the management strategies and activities of adjoining landowners can also diversify the ages, shapes, composition, and structure of the forest.

- 172 FRANKLIN, SCOTT B.¹, PHILIP A. ROBERTSON², BRIAN P. KLUBEK², JAMES S. FRALISH² AND FELIX PONDER³. ¹University of Memphis, ²Southern Illinois University, ³North Central Forest Experiment Station - Physiological diversity of soil microorganisms in burned and unburned upland hardwood stands.

In an effort to better understand the nutrient dynamics in relation to fire in upland hardwood forests, we examined soil samples from 30 days prior to a prescribed burn with soil samples from 30 days following a prescribed burn. Two sites were set up in a replicate block design, including control, burned once (1991), and consecutively burned (1991, 1994, 1997) treatments. This study was conducted from January to March, during the dormant season, 1997. Ten A horizon soil samples were extracted and combined for sample analyses. Half of each combined sample was stored in a cooler at 4°C and half of the samples were analyzed for nutrients; including pH, K, P, Ca, Mg, ENR, and CEC. Stored samples were used for determining dry weight of soil and for creating dilution series for microbial analysis; including the detection of organisms that produce urease, organisms that break the α or β 1,4 linkage of glucose, proteolytic organisms, lipolytic organisms, actinomycetes, *Nitrosomonas*, *Nitrobacter*, and denitrifying bacteria. Data on the change from pre to post sampling were analyzed with ANOVA. Microbial results are pending, but nutrient data show no significant differences between the control and consecutively burned samples. Significant differences did occur between the control and consecutively burned samples versus the burned once samples, with a greater decrease of phosphorus and a greater increase of calcium.

- 173 BEASLEY, RODNEY¹, PAUL DAVISON¹, FRANCIS MENAPACE¹, and DAN WUJEK². ¹University of North Alabama and ²Central Michigan University - *Caloglossa leprieurii*, an estuarine red alga in the Tennessee River and its growth in culture.

Caloglossa leprieurii, a red alga, is macroscopic, benthic, subcosmopolitan in distribution, and largely confined to estuaries but occasionally occurs in freshwater, coastal lotic systems. Recent collections made from the Tenn. River represent the first from freshwater in the U.S. and are apparently the most inland populations globally. Field surveys along the banks of the Tenn. R. show the species to occur abundantly at numerous locations spanning 160 miles from So. Pittsburg, Tenn. to Sheffield, Ala. Substrates include limestone riprap, native chert, cement blocks, base of *Justicia*, submerged wood, plastic debris, and monofilament fishing line. Whereas all field collected material is sterile, material cultured in 30 ml of nutrient enriched media at 25%, 50%, 75%, and 100% salinities of sea water have produced well-formed tetrasporangia and mature tetraspores after 4 weeks in culture. Cultures in nutrient enriched distilled water and sterilized Tenn. R. water remained vegetative. Given the limited extent of our field surveys, the total range of this typically marine red alga in the Tenn. River is unknown.

- 174 CHOBERKA, ERICA AND D.K. SMITH. University of Tennessee, Knoxville, TN 37996 - Bryophyte recruitment and succession on fir logs in the Great Smoky Mountain National Park.

This study provides a baseline assessment for epixylic bryophytes response to the habitat change of fir forests (5500-6600ft) in the GSMNP. A quantitative community analysis correlated to stand conditions and log decay history is being performed to study the effects of canopy loss and substrate gain on bryophyte colonization and succession. Ninety-one plots were sampled. Canopy cover, decay/succession class, log position, slope, and GPS coordinates were recorded. These data are being analyzed using SAS principle component analysis. The following bryophytes have been recorded: *Nowellia curvifolia*, *Scapania nemorosa*, *Jamesoniella autumnalis*, *Anastrophylum michauxii*, *Lophozia incisa*, *Bazzania trilobata*, *Lepidozia reptans*,

Blepharostoma trichophyllum, *Cephalozia catenulata*, *C. lunulifolia*, *Frullania asagrayana*, *Lophocolea heterophylla*, *Geocalyx graveolens*, *Riccardia palmata*, *Calypogeia suecica*, *Brotherella recurvans*, *Hypnum imponens*, *H. pallescens*, *Dicranum fuscescens*, *D. scoparium*, *Tetraxis pellucida*, *Thuidium delicatulum*, *Heterophyllum nemorosum*, *Polytrichum pallidisetum*, *Isopterygium elegans*, *Platygyrium repens*, *Hylacomium splendens*, *Rhytidadelphus triquetrus*, *Ptilium crista-castrensis*, and *Pleurozium schreberi*. The role of fir logs as a substrate for bryophytes in pristine fir forests was documented by Norris in 1964. Since then, the abundance of *Geocalyx graveolens*, *Anastrophyllum michauxii*, *Ptilium crista-castrensis* and *Hylacomium splendens* has greatly decreased. *Hypnum imponens*, *Thuidium delicatulum*, *Jamesoniella autumnalis*, *Bazzania trilobata*, and *Lophocolea heterophylla* has increased. The entire *Frullania* union, *Sphenolobus exsectus*, *Plagiothecium laetum*, *Dicrandontium denudatum*, and *Mnium punctatum* remain unreported for the current study, but were present in 1964. *Lophocolea heterophylla*, *Polytrichum pallidisetum*, and *Isopterygium elegans*, not treated as epixylic species by Norris, are currently on logs in closed forests. Bryophyte diversity beneath sparse canopy is low. Greater diversity occurs on logs in closed forests.

- 175 BURKHEAD, JULIETTE C., JILLIAN A. MARSHALL, AND LAWRENCE W. ZETTLER. Department of Biology, The Illinois College, Jacksonville, IL 62650 - *In vitro* symbiotic seed germination of the Florida Butterfly Orchid, *Encyclia tampensis*: Evidence of non-specificity for mycorrhizal fungi by an epiphytic orchid.

In vitro symbiotic seed germination of the Florida Butterfly Orchid, *Encyclia tampensis* (Lindley) Small, is reported. In nature, all orchids require mycorrhizal fungi (Basidiomycotina) to initiate seed germination and seedling development to an autotrophic stage. It remains unclear if orchids utilize a wide range of fungi, or if they display specificity towards particular strains of fungi. This dilemma is further exacerbated by a general lack of information regarding the identity of the endomycorrhizal flora, and its role on seed germination, particularly for tropical epiphytic taxa. In this study, seeds of *E. tampensis*, a commercially-exploited epiphytic orchid, were inoculated with a fungus (*Epulorhiza* sp.) originally isolated from a second epiphytic species, *Epidendrum conopseum* R. Brown. Nearly all (>99 %) seeds inoculated with the endophyte germinated within 21 days, whereas seeds incubated in the absence of the fungus (control) failed to germinate. Few (<1%) seedlings developed leaves, 42 days following inoculation; however, all appeared healthy. Our results, albeit derived *in vitro*, suggest that both *E. tampensis* and *E. conopseum* may be capable of utilizing the same endophytic fungus in nature, arguing against fungal specificity by *E. tampensis*.

- 176 JOHNSON, MARGARET AND PHILIP A. ROBERTSON. Southern Illinois University at Carbondale, Illinois - The effect of canopy closure on growth and reproduction in *Matelea obliqua*.

Previous research indicates that canopy closure may be an important factor limiting growth and reproduction in some populations of the Illinois State threatened species *Matelea obliqua*. To investigate this hypothesis, two non-reproducing populations from an upland and a lowland area were selected from the six populations previously studied. Following the removal of shrubs and the girdling of selected trees, canopy closure decreased from 94% to 27% at the lowland site and from 90% and 36% at the upland site. Leaf production increased at the lowland site from 11.4 to 25.7 leaves and at the upland site from 4.0 to 7.8 leaves per plant per sampling. Flower production increased at the lowland site from 0 to 7.9 flowers and at the upland site from 0.04 to 3.1 flowers per plant per sampling time. The lowland population produced an average of 0.17 pods per plant. No fruits were produced at the upland site. The increase in leaf and flower production indicates that canopy closure can limit growth and reproduction in *M. obliqua*, however the relatively low fruit production indicates other factors are also limiting reproduction in this species. This research is supported by the U.S. Forest Service.

- 177 MUNKACSI, ANDREW¹, JAMES VESELENAK¹, ANNE LARSON¹, AND LAWRENCE W. ZETTLER². ¹Dept. Biology, Univ. of Illinois - Springfield, IL 62794, ²Dept. of Biology, The Illinois College, Jacksonville, IL 62650 - A preliminary survey of the endomycorrhizal fungi of *Spiranthes magnicamporum* (Orchidaceae) from a native Illinois prairie.

A preliminary survey of the endomycorrhizal flora of a terrestrial orchid, *Spiranthes magnicamporum* Sheviak, is reported. Mycorrhizal fungi play a vital role in the ecological prosperity of host plants, and represent an essential component of restoration efforts projected for the 21st century. Orchids are particularly vulnerable because they are the only large group of plants that utilize mycorrhizal fungi as an alternative energy source (= mycotrophy) to sustain their life cycles in nature. Little information exists that describes or documents the endomycorrhizal flora of terrestrial orchids native to the United States. This dilemma was the incentive of the present study. Root sections of a mature *S. magnicamporum* specimen from a native Illinois prairie were excised, and fungal-infected cortical cells were plated on modified Melin-

Norkrans' agar (MNN). Emerging fungal hyphae were subcultured onto potato dextrose agar (PDA) and incubated to yield discernable morphological and cultural characteristics. Of the fungi recovered, two strains were tentatively identified as members of the anamorphic genera *Moniliopsis* and *Epulorhiza* (Basidiomycotina). These endophytes are presently being screened via symbiotic seed germination for their symbiotic potential, and if confirmed, the fungi will be deposited for potential use in native prairie restoration.

- 178 TAYLOR, DAVID D. USDA Forest Service, 1700 Bypass Road, Winchester, KY 40391. -Kentucky populations of the orchid *Platanthera integrilabia* - three years of observations.

Census data spanning three years, and including leaf and flower counts, are recorded for six Kentucky populations of *Platanthera integrilabia*. Census data spanning less than three years for other sites are also recorded. Based on these data, several observations are made. The total number of individual plants within a population is similar from year to year, although numbers of flowering plants are not. Year to year changes occur in the number of leaves and flowering plants per cluster within populations. Highest flower per scape and fruit set counts tend to occur in areas of 3500 lux or greater, usually open sites. A cold, wet spring in 1997 may have contributed to sharply lower numbers of flowering plants and seed set.

- 179 SUNLEY, JENNIFER A., TONYA WILSON DELANEY, AND LAWRENCE W. ZETTLER. Department of Biology, The Illinois College, Jacksonville, IL 62650 - Seed propagation of the epiphytic Green-fly Orchid, *Epidendrum conopseum*, using its endophytic fungus: Confirmation of mycorrhizal symbiosis.

Seed propagation of the epiphytic Green-fly Orchid, *Epidendrum conopseum* R. Brown, using a naturally-occurring fungus, is reported for the first time. It is widely accepted that mature epiphytic orchids depend less on symbiotic mycorrhizal fungi as an alternative energy source (= mycotrophy) than their temperate terrestrial counterparts, in general. We report the isolation of an endophytic fungus from the roots of a mature *E. conopseum* specimen that was identified as a species of *Epulorhiza* - a genus commonly associated with terrestrial orchids, but rarely documented in epiphytic orchids. Placement in that genus was confirmed following EM observation of septal ultrastructure that revealed imperforate parentheses. The symbiotic authenticity of the isolate was verified using the technique of symbiotic seed germination. Leaf-bearing seedlings of *E. conopseum* were obtained 71 days after seeds were inoculated with the fungus *in vitro*. Our results suggest that at least one epiphytic orchid species retains its symbiotically-active isolates at maturity. Because surprisingly few epiphytic orchid taxa have been examined for their endomycorrhizal flora, we suspect that fungi may play a heretofore underestimated dimension in epiphytic orchid ecology.

- 180 EMRICK, VERL AND ALISON HILL. U. S. Army Construction and Engineering Research Labs, Natural Resources Assessment and Management Division, P.O. Box 9005, Champaign, IL 61826-Density and Frequency of *Rhus michauxii*, a Federally Endangered Species, in Relation to Community Association at Fort Pickett Military Reservation, Virginia.

Rhus michauxii, a federally listed endangered species, was discovered at Fort Pickett Military Reservation, Virginia in 1993. Work conducted in 1994 determined the locations of *R. michauxii* colonies, and the composition of community associations in which *R. michauxii* occurred. Colonies of *R. michauxii* were found in two associations at Fort Pickett, an oak woodland association and an open shrubland association. Mean vegetative cover of *R. michauxii* was 12.5% in the oak woodland association and 41% in the open shrubland association. The intensity of disturbance, caused by military training, was greater in the open shrubland association. Colonies of *R. michauxii* in each association were systematically sampled, using 2.5 m² quadrats, for density and frequency of *R. michauxii* stems. The number of staminate, pistillate and gender neutral stems were tallied in each quadrat. There was no significant difference in gender neutral stems between associations. Of the colonies that contained both staminate and pistillate stems, 77% were in the open shrubland association and 23 % were in the oak woodland association. The open shrubland association had significantly ($P < 0.05$) more staminate and pistillate stems than the oak woodland association. The habitat provided by the open shrubland association appears to enhance the fecundity of *R. michauxii* at Fort Pickett.

- 181 ADAIR, MATTHEW S., P. BRENT NICHOLS, AND SAFAA AL-HAMDANI. Jacksonville State University-Effect of chromium (VI) on *Salvinia* growth and carbohydrate accumulation.

This study was designed to evaluate response of *Salvinia* growth, carbohydrate accumulation, and pigment concentration to 2.5 mg/l of chromium (VI). The experiment was carried out under a controlled

environment of 25°C , $250\ \mu\text{Em}^{-2}\text{s}^{-1}$, and 14 h of daylength. The plants were grown in 125 ml of diluted Hoagland solution (1:40) with a pH of 6.5. *Salvinia* growth was significantly reduced in the presence of the chromium. The same result was obtained for the chlorophyll a, chlorophyll b, and carotenoid. However, anthocyanin concentration was significantly increased in the medium where chromium was present. In addition, soluble sugar concentration, starch accumulation and total nonstructural carbohydrate concentration were significantly increased in the presence of the chromium. Furthermore, *Salvinia* was shown to be very effective in buffering its environment by changing the pH of the medium.

- 182 Porcher, Richard D., Patrick D. McMillan, and John F. Townsend - The Rediscovery of *Forestiera godfreyi* Anderson (Oleaceae) in South Carolina.

Forestiera godfreyi was first described by L.C. Anderson in 1985 from specimens collected from Florida and from one early specimen from South Carolina. The South Carolina specimen was collected by J.H. Mellichamp in the 1800's. Mellichamp's notation on the herbarium label gave the site as near Bluffton in Beaufort County. In 1995 the authors found *F. godfreyi* on a forested, elevated shell mound (of Indian origin?) at the intersection of Townsend Creek and the North Edisto River in Charleston County. In 1996 the senior author found a second population of *F. godfreyi* on a similar forested shell mound on Daws Island adjacent to Port Royal Sound in Beaufort County. Both mounds were elevated ten feet or more above the surrounding salt marsh and both mounds were associated with Indian shell rings. These are the only known populations of this rare shrub in South Carolina. We searched sites in and around Bluffton for Mellichamp's original population, but were unsuccessful.

- 183 SOBIERAJ, JAMES H. AND HOWARD S. NEUFELD. Dept. of Biology, Appalachian State University, Boone, NC 28608 - Differential susceptibility to cavitation in petioles of one and two year old leaves of *Galax aphylla*.

Galax aphylla is an herbaceous evergreen found in the understory of deciduous forests, primarily in the southern Appalachians. This habitat does not appear, at first glance, to be a stressful environment. However, *Galax* is shallowly rooted throughout the leaf litter and this top layer of soil can experience rapid changes in moisture content over a short period of time. Thus, these plants must tolerate occasional severe drought conditions, even though lower soil layers may not show signs of much drought. Previous research in our lab has shown that *Galax* leaves generally persist for two years, and therefore must also endure freezing events throughout the colder months. Both drought and freezing can result in cavitation of the xylem and formation of embolisms. Embolisms adversely affect the hydraulic conductivity (k_h) of the xylem. Our working hypothesis is that the buildup of cavitations due to drought and/or freezing contributes to the ageing process and eventual senescence of the leaves. Preliminary findings suggest there are no significant differences in the k_h of first and second year *Galax* petioles, nor were there any significant embolisms in petioles collected from the field in September of this year. But by late October, after multiple freeze events, first year leaves had significantly lower k_h than second year leaves, and were more embolized (51% vs 31%). These results suggest that perhaps freezing differentially affects first and second year old leaves. Future experiments will concentrate on the relative susceptibility of leaves to freezing- and drought-induced reductions in k_h .

- 184 COLLINS, LINDA T. AND BELL, REBEKAH P. University of Tennessee at Chattanooga - How to Teach Chi-Square Analysis in an Introductory Genetics Laboratory.

It is frequently difficult to teach chi-square analysis to introductory biology students, especially non-majors. They often have little background in statistics, and many are math-phobic. We have developed a method of teaching chi-square analysis in our introductory biology laboratory exercise in genetics by using Mendel's actual data for monohybrid and dihybrid crosses. First, students learn Mendel's Law of Segregation. Then they submit Mendel's data on flower color in the pea (monohybrid cross) to a chi-square analysis. Second, they learn Mendel's Law of Independent Assortment, and they submit Mendel's data of seed texture and color in the pea (dihybrid cross) to another chi-square analysis. By repeating the chi-square calculations with data from two different types of crosses, students learn how to use chi-square to determine probability that chance causes deviation from the expected. After they are familiar with chi-square analysis, they make hypotheses about the genotype of unknown ears of Indian corn. They test their hypotheses by subjecting their observed results to those expected by their hypotheses.

- 185 DURRANT, GARY, GEORGE CLINE, TOM BAUCOM, KELLY GREGG, AND FRANK ROMANO. Jacksonville State University, Jacksonville, AL 36265. Aerospace education across the curriculum: training high school science teachers in satellite remote sensing and Global Positioning Systems.

As part of our NASA EPSCoR grant in remote sensing, we have conducted two different sets of training workshops at JSU in geographic satellite technologies. These workshops were given under the auspices of the Alabama Aerospace Teachers Association (AATA) at JSU. AATA places a high value on teaching science to K-12 students using active, hands-on, learning projects. AATA also uses aerospace projects as a means of teaching science across the curriculum, with laboratory projects in physics, biology, geology, aeronautics, geography, chemistry, engineering, astronomy, and mathematics. We conducted workshops in three different satellite-based, geographic technologies. One of our workshops was a "scavenger hunt" using global positioning systems (GPS). These GPS systems have a base price of \$120, and AATA has a set of GPS units that can be loaned out to teachers for their science classes. Another workshop trained teachers in the use of the U. S. Military Academy's image analysis software (MicroMSI). This freeware can be downloaded off of the Internet at (<http://www.dean.usma.edu/geo/mcg/download.htm>), and includes a LANDSAT image of Washington DC. Our third workshop trained teachers in the use of NOAA's CCOAST system for analyzing satellite images of sea surface temperatures (SST's). CCOAST is freeware, and can be downloaded off of the Internet at (<http://phang.nmfs.hawaii.edu>). NOAA's CoastWatch sites have archives of SST imagery off of all of the U.S. coastlines. The teachers enjoyed these workshops, and we are planning to give them again in the near future.

- 186 KOPP, RICK. Dept. of Biological Sciences, Georgetown College, Georgetown, KY 40324 - Lessons from PAEMS: A summer science camp for highly-motivated high school students.

Georgetown College established its Pre-college Academic Experience in Math and Science (PAEMS) in 1991 to provide academically-motivated high school students (rising sophomores, juniors, and seniors) with educational opportunities that are not normally available in secondary schools. In the last seven years, 151 students from 22 states have taken modules in biology, environmental science, chemistry, computer science, and mathematics. We believe that programs such as PAEMS can play an important role in promoting enthusiasm in highly-motivated students and in giving these students a sample of college life. Our own experiences in conducting the program have led us to recognize the importance of: (1) a fairly rigorous application process that attracts conscientious students; (2) limited enrollment (usually 22); (3) a diverse curriculum; (4) active involvement by faculty outside of class; (4) a full schedule of activities; (5) field trips that demonstrate applications of science and provide a break from routine; (6) assessment procedures that include immediate and two-year follow-ups; and (7) external funding for scholarships so that all students who wish to attend are able to do so.

- 187 SAUTERER, ROGER AND JODY JONES. Dept. Biology, Jacksonville State University, Jacksonville, AL 36265 - A rapid, simple, and inexpensive laboratory experiment in gel filtration chromatography for undergraduate instructional laboratories.

We will describe and demonstrate a simple and inexpensive laboratory exercise in gel filtration chromatography for instructional laboratories that provides students with experience in pouring and running the columns, collection of fractions, and analysis of the resulting data, yet can be performed in a single two or three-hour laboratory session. This exercise offers significant advantages over commercially available laboratory chromatography exercises because: 1. It utilizes colored proteins of different sizes so that students can see the separation as it occurs and the absorbance of collected fractions is monitored using only an inexpensive visible spectrometer, 2. Students themselves pour and pack the columns, and common problems with improperly poured columns such as channeling of proteins are easily visible during the chromatographic run, and 3. A plot of the log molecular weight v. elution volume yields a straight line curve which can be used to estimate the molecular weight of an unknown protein during a second run. Aside from initial start-up costs to purchase gel filtration media, proteins, and plastic "disposable" columns or 10 ml pipettes, the experiment can be performed for about \$10 per classroom, far less expensive than commercially available chromatography exercises. Although this exercise is designed for sophomore-junior undergraduate laboratories, it can be adapted for more advanced courses or for advanced high school laboratories as well.

- 188 ADAMS, JASON R. AND GEORGE R. CLINE. Jacksonville State University - Survey results from the Fort McClellan Herpetofaunal Inventory and Monitoring Project (Aug 1996 - Mar 1998).

The goal of the North American Amphibian Monitoring Program (NAAMP) is to create a nationwide protocol for amphibian inventory and biological monitoring to accurately assess amphibian population dynamics. Establishing local inventories and monitoring amphibians is crucial to assess the status of these

populations (Heyer, et. al. 1994). Ft. McClellan, Alabama, has been documented (Whetstone et al. 1996) to contain many diverse herpetofaunal communities. Three areas on the Main Post which are being routinely monitored include Reilly Lake, Yahoo Lake, and Three Mile Pond on Range 19D. Several NAAMP protocols were utilized to monitor herp abundance including : 1) Timed visual encounter surveys, 2) Extended road cruises, 3) Drift fencing, 4) Call chorus indexing and 5) Standard sweeps with a dip net. Results from an 18 month survey indicate that Ft. McClellan contains ~90% of all herp species expected to occur in northeast Alabama including: 16 anurans, 11 caudatans, 5 lacertilians, 17 ophidians, and 7 chelonians.

- 189 HIMES, JOHN. Louisiana State University in Shreveport. - Autecology of the Louisiana pine snake (*Pituophis melanoleucus ruthveni*) in north-central Louisiana.

The autecology of the Louisiana pine snake (*Pituophis melanoleucus ruthveni*) was studied by radiotelemetry during 1995-1997. Over 1,300 locations for nine adults and one juvenile were studied. Snakes were usually located in mammal burrows during all seasons and on both, cloudy and sunny days. Snakes were aboveground most frequently during spring and fall and during early morning and late evening. Snakes preferred pine forest or pine plantation habitat >200 m from the nearest habitat edge. Snakes selected against clearcuts and hardwood-dominated forest. To measure habitat preferences, habitat was analyzed in an 11.2 m (radius) plot at each snake location and at 100 randomly selected plots. The number of trees and logs was similar between plot types. The most common tree on snake plots was loblolly pine. Most logs on the snake plots were decomposed, non-hollow, and slightly wider and longer than logs on random plots. Snakes were occasionally tracked to self-made burrows, most of which dead-ended or tapped into mammal burrows. More self-made burrows were excavated in forest. Recognition of pine snake burrows may help determine the presence of this highly secretive and uncommon snake.

- 190 GILLETTE, JENNIFER R., ROBERT G. JAEGER, AND MEGAN E. GIBBONS. Dept. of Biology, University of Southwestern Louisiana, Lafayette, LA 70504 - Intersexual association preferences in the red-backed salamander, *Plethodon cinereus*: fickle or faithful?

Male-female pair associations are common in some taxa, especially in birds and some mammals, but virtually unknown in amphibians. Adults of both sexes of the red-backed salamander (*Plethodon cinereus*) maintain and defend territories from both conspecific and congeneric intruders. Territories held by individuals of this species typically overlap intersexually but not intrasexually, which indicates that spacing patterns are not random. Furthermore, male-female pairs, but not same-sex pairs or trios, are often found cohabiting in their natural habitat, even outside of the courtship seasons. Our research examined the intersexual association preferences of males and females that were found cohabiting in male-female pairs. Both males and females from pairs captured during the autumn courtship season showed significant preferences for the salamanders with which they were found rather than unfamiliar salamanders. These preferences were not significant in male-female pairs captured and tested during the non-courtship season. We hypothesize that adults of these salamanders may, in some cases, form long-term intersexual pair associations.

- 191 BRIDGES, ANDREW¹ AND MICHAEL E. DORCAS. The University of Georgia's Savannah River Ecology Laboratory, Aiken, SC. ¹Current address: Dept. Wildlife and Fisheries, Texas A&M Univ., College Station, TX. - Temporal Variation in Anuran Calling Behavior: Implications for Calling Surveys and Population Assessment

Recent awareness of amphibian declines has raised the need for effective monitoring programs. Calling surveys are a standard approach to monitoring populations of most anuran species. However, temporal variation in calling activity may result in failure to detect some species. Automated recording systems allow consistent sampling for extended periods with little or no disturbance to calling anurans. We used an automated recording system to measure temporal variation in anuran calling activity during the Summer of 1997 at a Carolina bay on the Savannah River Site, SC. We documented considerable interspecific variation in calling activity, a phenomenon that would result in the failure to detect some species using traditional calling survey techniques. In particular, we found that southern leopard frogs (*Rana sphenoccephala*), previously thought to breed only in early Spring and Fall in the region, called consistently from midnight until dawn. Because protocols for most calling surveys dictate that the listener only survey during early evening hours, most calling surveys would not

detect the presence of this species. These results illustrate that temporal variation in anuran calling activity warrants further investigation. More importantly, these results emphasize the need for consideration of temporal variation in anuran calling when developing anuran monitoring programs.

- 192 GIBBONS, MEGAN E., JENNIFER R. GILLETTE, AND ROBERT G. JAEGER. Dept. Biology, University of Southwestern Louisiana, Lafayette, LA 70504 - Alternative life styles in a terrestrial salamander: are females found in same-sex pairs attracted to each other?

The red-backed salamander (Plethodon cinereus: Plethodontidae) appears to have evolved a complicated social system. We found several female-female pairs under cover objects in October (breeding season) at our study site. There was neither a significant difference between the number of male-female pairs that were found and the number that would be expected by random chance, nor between the number of female-female pairs that were found and the number that would be expected by random chance. However, we found significantly fewer male-male pairs than would be expected by random chance. We conducted an experiment that gave each female from same-sex pairs the choice of association between the individual with which she was found in the forest and an unfamiliar female from another same-sex pair. Females from same-sex pairs showed no preference for individuals with which they were found. Based on these data, females of P. cinereus are more likely to be found in same-sex pairs during the breeding season than are males. We attempt to interpret these data in terms of: (1) potential shifts in territorial behavior of P. cinereus during the breeding season and (2) potential benefits to females gained by cohabiting territories in same-sex pairs.

- 193 MORGAN, CHRISTINA D. AND REBECCA A. PYLES. Dept. Biological Sciences, East Tennessee State University, Johnson City, TN 37614 - Niche partitioning in a community of salamanders.

Diet, habitat and seasonality are common parameters used to investigate niche partitioning. In order to determine whether these parameters partitioned salamander species, a community on Buffalo Mtn. (Washington Co, TN) was studied. This community was sampled along a 608 x 2m transect that crossed six habitat types. Location and date of collection were recorded, diets were determined by identification of stomach contents. Ten species of plethodontid salamander were observed during ten of 13 months (June, 1995 through June, 1996). Frequencies of salamanders and prey were tested using the Kolmogorov-Smirnov two-sample test. Similarity of species and diet composition were compared using an Index of Similarity (IS=0.0-1.0). The community comprised two sub-communities that were linked by a common member, Desmognathus ochrophaeus, which was found in all habitats except deciduous forest. Three plethodontid species were collected only from deciduous and rhododendron forests. Six desmognathine species were collected in moister habitats (stream, stream edge and two seeps). All salamanders had similar diet composition (IS=0.61--0.81). However, five of seven species tested had different prey frequencies, three species were excluded owing to small sample size. Prey frequencies in the spring were different from other seasons. Salamander frequencies were similar for all seasons. Detected differences in habitat ranges and prey frequencies among species indicate potential for niche partitioning by sub-community. Conversely, similarity of habitats, diet composition, and seasonality of species indicate areas of significant niche overlap.

LATE PAPER ADDITIONS

WILLIAMS, L. DENISE and HOWARD S. NEUFELD. Appalachian State University--Factors Affecting Growth and Reproduction in *Microstegium vimineum*, a Shade-Tolerant, Exotic C₄ Grass.

Microstegium vimineum is an exotic grass that invades disturbed, mesic forests up and down the eastern United States. This plant was first noted in the United States shortly after the turn of the century, and has since spread to most states east of the Mississippi River. This species is an annual, and seeds may persist in the soil for at least seven years. The objective of our study was to determine which abiotic and biotic factors affected growth and reproduction in this noxious species. We measured light (using hemi-spherical photography), soil moisture at two depths, and the presence of other species in five different sites in Cades Cove, Great Smoky Mountains National Park, and one site three miles east of Cades Cove. Aboveground biomass/m² of the *M. vimineum*, density, phenological parameters, and seed production were measured for each site. Multiple linear regression showed that variation in biomass/m² and density were best explained by a combination of percent sunlight, soil moisture, and presence of other species. In high light sites, biomass was negatively correlated with the presence of other species. Low light sites had little or no other species present. Mean plant biomass was highly correlated with percent direct sunlight, but inversely related to density. A log-log plot of biomass vs density showed a slope of -1.23. Seed production was highly related to plant biomass, and the largest 25% of the plants produced nearly 50% of all the seeds. Seeds/m² ranged from 16,000 to over 50,000. Seed germination studies showed no innate dormancy, suggesting seed bank formation results from burial and lack of light, rather than innate dormancy mechanisms. The significance of these findings for resource managers will be discussed.

CULTON, DONNA A., CARTAYA-MARIN, CLAUDIA P., SOEDER, ROBERT W., HENSON, RICHARD N., and HOWARD S. NEUFELD. Appalachian State University--Isolation and partial characterization of the compound(s) responsible for photoluminescence in the scorpion *Centruroides vittatus*.

Scorpions worldwide are known to fluoresce under long wave ultraviolet (UV) light. The significance (if any) of this phenomenon to the scorpions is not understood at present and the compound(s) responsible for this photoluminescence have not yet been identified. The objective of this project is to isolate and characterize the compound(s) responsible for fluorescence in the common southwestern scorpion, *Centruroides vittatus*. An earlier study by other researchers had suggested the fluorescence was due to a single flavonoid compound, but our early results suggested that (1) the compound was not a flavonoid, and (2) there seems to be more than one fluorescent compound. We extracted fluorescent compounds from scorpion cuticle into ethanol using a Soxhlet apparatus, and then separated them using flash chromatography. The material obtained was partially characterized using spectroscopic methods. Optimal excitation wavelengths were between 340-380 nm and using 340 nm as the excitation light source, the emission spectra showed a peak centered at 440 nm. Infrared spectra showed the presence of the following functional groups: carboxylic acid, secondary amine, and a conjugated carbonyl. The spectral analysis also suggested that this compound was aromatic. The ¹H NMR spectra confirmed that the compound was indeed aromatic, and possibly an ortho-substituted benzene. Future work will include two dimensional ¹H and ¹³C NMR to further characterize the structure of these compounds.

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In This Issue

PRESIDENT'S CORNER: A VIEW FROM HERE	33
PROGRAM OF THE 59 TH ANNUAL MEETING OF THE ASSOCIATION OF SOUTHEASTERN BIOLOGISTS	35
GENERAL INFORMATION	37
ASB CANDIDATES FOR OFFICE - 1998	40
PLENARY SPEAKER	44
PROGRAM SUMMARY	45
ASB PAPER AND POSTER SESSIONS	48
BETA BETA BETA PAPER AND POSTER SESSIONS	69
REVISED PRE-REGISTRATION FORM	72
AUTHOR INDEX FOR PAPERS AND POSTERS WITH ABSTRACT NUMBERS	74
ERRATUM	75
REVIEWS	76
NEWS OF BIOLOGY IN THE SOUTHEAST	80
POSITIONS AVAILABLE	82
ABSTRACTS	83

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ONLY CALL FOR PAPERS FOR THE 1999 MEETING

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Diplocentrus whitei taken with the natural fluorescence from exposure to ultraviolet light.

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Treasurer: Gerhard Kalmus, Dept. of Biol, East Carolina University, Greenville, NC 27858-4353; (252)328-6306; kalmusg@mail.ecu.edu

Archivist: Sandra Bowden., Dept. of Biology, Agnes Scott College, Decatur, GA 30030 (404)638-6268; sbowden@ness.agnesscott.edu; FAX (404)638-5368

Executive Committee Members-at-Large:

1999: Douglas A. Rayner, Dept. Biol., Wofford College, Spartanburg, SC; (864)597-4624; raynerda@wofford.edu

Dwayne Wise, Dept. of Biol. Mississippi State University, Drawer GY, Mississippi State, MS 39762-5759; (601)325-7579; daw@ra.msstate.edu.

2000 Patricia Cox, Div. of Biol., 301 Hesler Hall, University of Tennessee, Knoxville, TN 37996; (423)974-6225; pbcox@utkux.utcc.utk.edu

Terry Richardson, Dept. of Biol. UNA Box 5212, University of North Alabama, Florence, AL 35632-0001; (205)765-4429; trichard@unanov.una.edu

2001 George Cline, Dept. of Biol., Jacksonville State Univ., Jacksonville, AL 36265; (256)782-5798 gcline@jsucc.jsu.edu

Joe Pollard, Dept. of Biol., Furman University, Greenville, SC 29613-0418; (846)294-3249; pollard@furman.edu

PURPOSE

The purpose of this association shall be to promote the advancement of biology as a science by encouraging research, the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. Members receive the ASB Bulletin.

TIME AND PLACE OF FUTURE MEETINGS

1999 April 14-17 University of North Carolina at Wilmington, Wilmington, NC
2000 April 5-8 University of Tennessee at Chattanooga, Chattanooga, TN

ASSOCIATION AFFAIRS

EDITOR'S COMMENTS

NEW PUBLICATION DATES, NEW FORMAT AND NEW LOGO

As I hope you noticed, you did not receive a July issue of the *ASB Bulletin*. In the annual business meeting in April the membership approved a plan whereby the *ASB Bulletin* would be published in January, April and September, with a special issue published during the year, but not at a specified time. The reasoning behind this consisted of two main points: 1. Much of the material in the July and October issues was redundant (two calls for papers, announcement of the next Annual Meeting *etc.*) and, since many people are not at their institutions in the summer, the July issue was not as widely read as the other issues. 2. We have continued to try to make the *ASB Bulletin* more relevant to the membership, and the four issues had become rather routine. A fourth "special issue" could be devoted to a number of items that we had wanted to try. This issue will have no Association business in it. Before the end of the year you will receive our first "special issue." I hope that it will have a lot of material that you will find interesting and relevant to you as a biologist in the Southeast. I plan for it to cover at least one somewhat controversial topic, with both sides represented by respected biologists. If you have a topic that you would like to see covered, please let me know. If any research papers are submitted they will appear in that issue. The other three issues will be primarily devoted to Association business and the Annual Meeting.

Beginning with the January, 1999 issue you will see our new logo. It is very similar to the old one, except that the "Southeast" is not so circumscribed. We have extended the state boundaries of several surrounding states in an indefinite manner, indicating that our membership and interest is centered on, but not restricted to, the states that have traditionally been identified with our Association. This represents the reality of our membership and interest. This logo was approved at the last business meeting.

Please let us have your input as to the new publication schedule, the new format of the "special issue", and the new logo. You may contact me or any member of the Publications Committee; Chair: Douglas R. Rayner, Department of Biology, Wofford College, Spartanburg, SC, 29301, (864)597-4624; Patricia Cox, Division of Biology, University of Tennessee, 301 Hester Hall, Knoxville, TN 37996, (423)974-6225, pbcox@utkux.utccc.utk.edu; George Cline, Department of Biology, Jacksonville State University, Jacksonville, AL 36265, (256)782-5798. The Association of Southeastern Biologists and the *ASB Bulletin* belong to you, and we hope we are better serving your interests.

Ken Shull, Editor
ASB Bulletin

**EVENTS OF THE 1998 ANNUAL MEETING
AT NORTHEAST LOUISIANA UNIVERSITY**

**Ed Clebsch
1998 MERITORIOUS TEACHER**

The recipient of the 1998 ASB Meritorious Teacher Award is Professor Emeritus of Botany and Ecology at the University of Tennessee, Dr. Edward E. C. Clebsch.

Ed is familiar to most of us, having participated in ASB for many years. His contribution to teaching students (young and old, amateur and professional) was recognized by the University of Tennessee with the Community Outreach Service Award in 1990 and by the Southern Appalachian Botanical Society's Bartholemew Service Award in 1992. He was educated at the University of Tennessee and Duke University. While his professional experience has taken him far and wide, he is a lifelong resident of the southeast and is apparently nowhere more comfortable than in the forest outside his backdoor.

He has published extensively on the vegetation of the Great Smoky Mountain National Park, directed the graduate studies of 49 students, helped organize the Smoky Mountains Field School and been a major contributor to the Great Smoky Mountain Spring Wildflower Pilgrimage. His unique style as an educator can be ascertained by a few comments, contained in the letters of support from his former students and colleagues.

"He takes his students off the beaten path and literally right into the woods, making that the classroom."

"As good as he was in the classroom, he was even better in the field."

"Field trips were unique learning experiences."

"Has taught in the unorthodox classroom of the bow of a white-water canoe"

"He spent many weekends in the field with students and continues to do so after retirement."



Ken McLeod presents the 1998 Meritorious Teaching Award to Ed Clebsch

"A giant among teachers amidst the giants of trees he so dearly loves"

"He was an unrelenting fount of information"

"A learning experience I will never have again and one I will treasure all my life"

"Continues to pursue knowledge with unabated zeal.... and transfer this curiosity and excitement to his students"

"I have heard excellent commentary on his abilities to bring brightness to listener's eyes through his learned approach to natural history and outdoor education."

"Wisdom has a way of transpiring out of such men without the need of a lesson plan, syllabus, or podium."

And on a more individual, personal level, others noted:

"I know that I echo the sentiments of many, many others when I say that I wish I could spend more time with him."

"Concern for me as a human being in addition to his concern for me as one of his many students"

"He has set an enduring model not only in his approach to doing science but also in the development of young scientists and in their contributions to society."

It is with great pride that the Association of Southeastern Biologists acknowledges Dr. Edward E. C. Clebsch as the recipient of the 1998 Meritorious Teaching Award.

1998 RESEARCH AWARD RECIPIENTS

ASB SENIOR RESEARCH AWARD: sponsored by The William C. Brown Publishing Co. was presented by Dwayne Wise to John Herr of the University of South Carolina for his paper "On the origin of leaves: the telome theory revised". *ASB Bul. Abstr.* 106, 45(2), 1998. Dr. Herr becomes only the fourth member of the Association to win the Research Award, the Meritorious Teaching Award and serve as President of the organization.



John Herr receives the 1998 Senior Research Award from Dwayne Wise

STUDENT RESEARCH AWARD: supported by the Martin Microscope Co. of Easley, SC was presented by Jeri Higgenbotham to Ben Cash for his paper: "Corticosterone and behavior in the freshwater turtle, *Trachemys scripta elegans*". *ASB Bul. Abstr.* 155, 45(2), 1998 co-authored with R. L. Holberton. Mr. Cash is a graduate student at the University of Mississippi, Oxford, MS.

ASB POSTER AWARD: The ASB Poster Award was presented by Terry Richardson to Donald E. Trisel and David L. Gorchov of Fairmont State College and Miami University for their poster: "Competitive effects of an invasive ornamental shrub *Lonicera maackii* on *Acer saccharum* seedlings". *ASB Bul. Abstr.* 24, 45(2), 1998.

SE DIVISION, AMERICAN SOCIETY ICHTHYOLOGISTS AND HERPETOLOGISTS AWARD in ichthyology was presented by Carl Johnson to Martin T. O'Connell of The University of Southern Mississippi, Hattisburg, MS for his paper: "Does the temporary habitat of an inundated floodplain offer increased food resources to fishes in a low order, blackwater habitat?" *ASB Bul. Abstr.* 111, 45(2), 1998. The award for herpetology was presented to John Himes of Louisiana State University in Shreveport for his paper "Autecology of the Louisiana pine snake (*Pituophis melanoleucus ruthveni*) in north-central Louisiana.

EUGENE P. ODUM AWARD: (\$250/plaque) was presented by John Aho to Andrew Bridges and Michael E Dorcas of Texas A&M University and the University of Georgia for their paper: "Temporal variation in anuran calling behavior: implications for calling surveys and population assessment." *ASB Bul. Abstr.* 189, 45(2), 1998



Jeri Higgenbotham presents the Student Research Award and the Student Research Award in Aquatic Biology to Ben Cash

SOUTHERN APPALACHIAN BOTANICAL SOCIETY AWARDS:

RICHARD AND MINNIE WINDLER AWARD

The Richard and Minnie Windler Award recognizes the best systematic botany paper published in *Castanea*, The Journal of the SABS, in the past year. The award for 1998 was presented by Bruce A. Sorrie, Brian Van Eerden & Mary F. Russo for "Noteworthy Plants from Fort Bragg and Camp Mackall, North Carolina (Dec. Issue of *Castanea* 62(4):239-259.

ELIZABETH ANN BARTHOLOMEW SERVICE AWARD: The Elizabeth Ann Bartholomew Award is presented to individuals who have distinguished themselves in professional and public service that advances our knowledge and appreciation of the world of plants and their scientific, cultural and aesthetic values. The 1998 award was presented by Ruth Douglas to Dan Pitillo, Professor of Biology, Western Carolina University, Cullowhee, NC.

NORTH CAROLINA BOTANICAL GARDEN AWARD was presented by Dan Pittilo to Erica Choberka and D. K. Smith of the University of Tennessee, Knoxville, whose paper was titled: "Bryophyte recruitment and succession on fir logs in the Great Smoky Mountains National Park" .*ASB Bul.* Abstr.174, 45(2).

STUDENT RESEARCH AWARD IN AQUATIC BIOLOGY: sponsored by Wildlife Co. (Wildco) was presented by Jeri Higgenbotham to Ben Cash for his paper: "Corticosterone and behavior in the freshwater turtle, *Trachemys scripta elegans*". *ASB Bul.* Abstr. 155, 45(2), 1998 co-authored with R. L. Holberton. Mr. Cash is a graduate student at the University of Mississippi, Oxford, MS.



Andrew Bridges and Michael Dorcas earned the Eugene P. Odum Award. Presenting the award is John Aho.

**THE ASSOCIATION OF SOUTHEASTERN BIOLOGISTS
TREASURER'S REPORT
I JANUARY - 31 DECEMBER 1997**

I. BEGINNING BALANCE		\$35,328.17
II. RECEIPTS		
Regular Dues	\$20,400.00	
Patron Memberships	500.00	
Interest	1564.25	
Wildco		
Award	200.00	
Plaque	34.00	
Meeting Revenue:	13,720.08	
Sales	124.00	
Enrichment	3,314.00	
TOTAL RECEIPTS		\$39,856.33
III. TOTAL RECEIPTS AND BEGINNING BALANCE		\$75,184.50
IV. DISBURSEMENTS		
1. Membership Refund	25.00	
2. Publication		
ASB Bulletin 44(1)	2,205.13	
ASB Bulletin 44(2)	6,173.03	
ASB Bulletin 44(3)	2,445.00	
ASB Bulletin 44(4)	1,864.29	
Printing	257.11	
Total Publication	12,944.56	
3. Office Expenses	0.00	
4. Official Travel	1,087.39	
5. Awards and Honoraria		
Graduate Student Support Grants	3,779.00	
Aquatic Biology Award	200.00	
ASB Research Awards	500.00	
Student Research Award	500.00	
Certificates/Plaques	256.45	
ASB Poster Award	300.00	
SREL Outreach Program	500.00	
Institute of Ecosystem Studies	200.00	
Total Awards	6,235.45	
6. Miscellaneous		
AIBS Affiliation	100.00	
Bank Charges, Refunds	168.00	
Local Committee	500.00	
Total Miscellaneous	768.00	
TOTAL DISBURSEMENTS		\$21,060.40
V. BALANCE		\$54,124.10
VI. NET CHANGE FOR 1997		\$18,795.93

1998 PROPOSED BUDGET

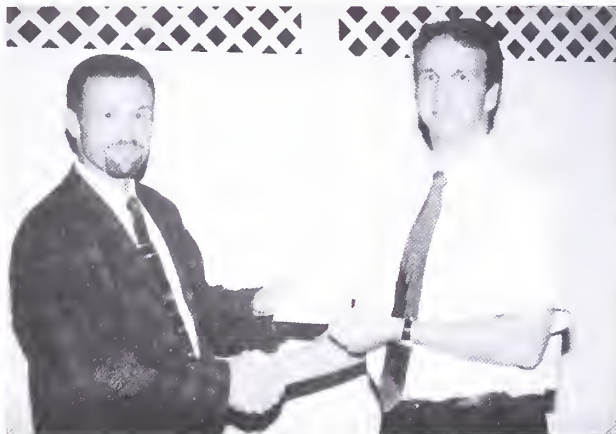
I.	BEGINNING BALANCE		(ASSUME) \$35,000.00
II.	RECEIPTS		
	Regular Dues	\$15,950.00	
	Patron Memberships	2,000.00	
	Interest	1,500.00	
	Wildco	200.00	
	Society of Wetland Scientists, South Atlantic Chapter	500.00	
	Meeting Revenue: Exhibition	3,000.00	
	Sales	250.00	
	Registration	6,000.00	
	TOTAL RECEIPTS		\$29,400.00
III.	TOTAL RECEIPTS AND BEGINNING BALANCE		\$64,400.00
IV.	DISBURSEMENTS		
1.	Dues Notice	500.00	500.00
2.	Publication		
	ASB Bulletin 45(1)	3,000.00	
	ASB Bulletin 45(2)	8,000.00	
	ASB Bulletin 45(3)	3,500.00	
	ASB Bulletin 45(4)	3,000.00	
	Misc. Publications	200.00	
	Total Publication		17,700.00
3.	Office Expenses		
	Web Page Development	500.00	500.00
4.	Official Travel	1,000.00	1,000.00
5.	Awards and Honoraria		
	Graduate Student Support Grants	4,000.00	
	Aquatic Biology Award	200.00	
	Speaker Honorarium	1,000.00	
	Speaker Travel	500.00	
	Research Awards	1,200.00	
	Certificates/Plaques	200.00	
	Poster Award	300.00	
	Total Awards		7,400.00
6.	Miscellaneous		
	Affiliations	400.00	
	Local Committee		500.00
	Symposia, Workshops	1,200.00	
	Bank Charges	200.00	
	Total Miscellaneous		2,300.00
	TOTAL DISBURSEMENTS		\$29,400.00
V.	NET BALANCE FOR YEAR		0.00
VI.	BALANCE FORWARDED		\$35,000.00

ENRICHMENT FUND
I JANUARY - 31 DECEMBER 1997

I. Beginning Balance		\$22,145.00
II. Receipts		
1. Gifts	3,314.00	
2. Interest	1,130.56	
Total		4,444.56
III. Total Receipts and Beginning Balance		26,589.56
IV. Total Disbursements		0.00
V. Ending Balance		26,589.56
VI. Net Change for 1997		4,444.56

CASH ON HAND
31 DECEMBER 1997

	ASB Fund	Enrichment	Total
Merrill Lynch			
CMA Money Fund	11,298.00	0.00	11,298.00
CMA Cash	1.18	0.00	1.18
Govt. Securities	0.00	23,269.00	23,269.00
Subtotal	12,299.18	23,269.00	34,568.18
Wachovia	45,600.16	0.00	45,600.16
Total	57,899.34	23,269.00	80,168.34



The second annual Poster Award was earned by Donald Trisel and David Gorchov. Terry Richardson presented the award.

**ASB OFFICERS, COMMITTEES AND REPRESENTATIVES AND
ASB BULLETIN STAFF, 1998 - 1999**

Telephone numbers, FAX numbers and E-mail addresses
can be found on the inside front cover of each issue of the *ASB Bulletin*.

ASB Bulletin Staff

Editor	J. Kenneth Shull, Jr., Department of Biology, Appalachian State University, Boone, NC
Associate Editor	Andrew Ash Department of Biology, Pembroke State University, Pembroke, NC
Business Manager	Gerhard Kalmus, Department of Biology, East Carolina University, Greenville, NC
News Editor	Jon Fortman, Division of Science and Mathematics, Mississippi University for Women, Columbus, MS
Book Review Editor	Frank Schwartz, Institute of Marine Sciences, University of North Carolina, Morehead City, NC

ASB Officers

President	Eloise Carter, Department of Biology, Oxford College of Emory University, Oxford, GA
President-elect	Pat Parr, P. O. Box 2008, Oak Ridge National Laboratory, Oak Ridge, TN
Vice-President	Robert Hayes, Department of Biology, University of Alabama, Tuscaloosa, AL
Past President	Whit Gibbons, Savannah River Ecology Laboratory, P.O. Drawer E, Aiken, SC
Secretary	Andrew Ash, Department of Biology, Pembroke State University, Pembroke, NC
Treasurer	Gerhard Kalmus, Department of Biology, East Carolina University, Greenville, NC
Archivist	Sandra Bowden, Department of Biology, Agnes Scott College, Decatur, GA



Out-going President Whit Gibbons presents the gavel to the new president, Eloise Carter

Executive Committee Members-at-Large

- 1999: Doug Rayner, Department of Biology, Wofford College, Spartanburg, SC
 Dwayne Wise, Department of Biology, Mississippi State University, Starkeville, MS
- 2000: Patricia Cox, Division of Biology, University of Tennessee, Knoxville, TN
 Terry Richardson, Department of Biology, University of North Alabama, Florence, AL
- 2001: George Cline, Department of Biology, Jacksonville State University, Jacksonville, AL
 Joe Pollard, Department of Biology, Furman University, Greenville, SC

ASB Committees

AAAS Representative (Section G): James W. Ross, Biology Department, Cumberland College, 7196 College Station Drive, Williamsburg, KY 40769-1382, (606)539-4380

AIBS Representative: Geraldine Twitty, Biology Department, Howard University, Washington, DC 20059, (202)806-6953, Fax: (202)806-4564

Auditing Committee: Chair: Vincent Bellis, Jr., Biology Department, East Carolina University, Greenville, SC 28785, blbellis@ecuvm.cis.ecu.edu, (919)757-6296

Committee on Women, Minorities and the Disabled: Chair: Hank Bart, Tulane University, Museum of Natural History, Building 3-A, Main St. to Wild Boar, Belle Chasse, LA 70037 (504)394-1711; Lonette Edwards, U.S. Forest Service, Department of Plant and Soil Science, PO Box 1387, Alabama A & M University, Normal, AL 35762; Sue Carstensen, Biology Department, Columbia College, Columbia, SC 29203, (803)786-3012.

Conservation Committee: Chair: Gary Walker, Department of Biology, Appalachian State University, Boone, NC 28608, (704)262-2672; Doug Rayner, Department of Biology, Wofford College, Spartanburg, SC, (864)597-4624, raynerda@wofford.edu; Nancy Coile, FDACS - Division of Plant Industry, PO Box 147100, Gainesville, FL 32614-7100, coilen@doacs.state.fl.us.

Education Committee: Co-Chair: Rich Kopp, Department of Biological Science, Georgetown College, Georgetown, KY 40324-1696, (502)836-8087; Co-Chair: Francis Kennedy, Department of Biology, State University of West Georgia, Carrollton, GA 30117, (707) 836-4544; John Aliff, DeKalb College, Decatur, GA 30243, (404)339-2328; Herbert House, Department of Biology, Elon College, Elon College, NC 27244, (910)584-2294; Larry Wilson, Fernbank Science Center, 156 Heaton Park Drive, Atlanta, GA 30307, (404)378-4314 ext. 331, larrywilson@fernbank.edu; William Dobson, Biology Department, Appalachian State University, Boone, NC 28608, (828)262-6910, dobsonwe@appstate.edu

Finance Committee: Chair: Gerhard Kalmus, Department of Biology, East Carolina University, Greenville, NC 28785, (919)328-6306; J. Whitfield Gibbons, Savannah River Ecology Laboratory, Drawer E, Aiken, SC 29802, (803)725-3533, gibbons@srel.edu; Pat Parr, Oak Ridge National Laboratory, PO Box 2008, Oak Ridge, TN 37831-6034, (423)576-8123, par@cosmail1.ctd.ornl.gov; Joe Pollard, Biology Department, Furman University, Greenville, SC 29613.

Graduate Student Support Award Committee: Chair: Gary Walker, Department of Biology, Appalachian State University, Boone, NC 28608, (828)262-2672; Mike Dorcas,

SREL, Drawer E, Aiken, SC 29802, (803)725-5293, dorcas@srel.edu; Dean Cocking, Department of Biology, James Madison University, Harrisonburg, VA 22807, (540)568-6566, cockinwd@jmu.edu.

Local Arrangements and Program Committee for 1998: Chair: Robert George, Biological Sciences, Univ. of North Carolina at Wilmington, Wilmington, NC 28403-3297, georger@uncwil.edu, (910)962-3487; Program Chair: Frank Schwartz, University of NC, Institute of Marine Science, 3431 Arendall Street, Morehead City, NC 28557, (919)726-8641.

Meritorious Teaching Award Committee: Chair: Robert F. McGuire, Biology Department, University of Montevallo, Station 6463, Montevallo, AL 35115, (205)665-6463; Don Dimock, Wake Forest University, Winston-Salem, NC 27106-5848, (910)759-5567; Stewart Ware, Department of Biology, College of William & Mary, PO Box 8795, Williamsburg, VA 23187, (757)221-2233, Fax: (757)221-6483, saware@facstaff.wm.edu

Nominating Committee of 1998: Chair: Jim Fralish, Department of Forestry, Southern Illinois University, Carbondale, IL 62901, (618)453-7466, fralish@siu.edu; Mike Baranski, Department of Biology, Catawba College, Salisbury, NC 28144, (704)637-4442; Beverly Collins, Savannah River Ecology Laboratory, Drawer E, Aiken, SC 29802, (803)725-3533.

Past President's Council: Chair: Jim Fralish, Department of Forestry, Southern Illinois University, Carbondale, IL 62901, (618)453-7466, fralish@siu.edu.

Place of Meeting Committee: Chair: James B. Clairborne, Department of Biology, Georgia Southern University, Statesboro, GA 30460-8042; Joe Pollard, Department of Biology, Furman University, Greenville, SC 29613; Kim Tolson, Biology Department, Northeast Louisiana University, Monroe, LA 71209, bitolson@alpha.nlu.edu

Poster Awards Commifftee: Chair: Michael E. Held, Department of Biology, Saint Peters College, Jersey City, NJ 07306, (201)915-9187; John Aho, Department of Biology, Auburn University of Montgomery, Montgomery, AL (334)244-3787; George Cline, Department of Biology, Jacksonville State University, Jacksonville, AL 36265, (256)782-5798; Steve Baker, Department of Biology, Oxford College of Emory University, Oxford, GA, 30054, (770)784-8446, sbaker@emory.edu, Fax: (770)784-8423.

Publications Committee: Chair: Douglas R. Rayner, Department of Biology, Wofford College, Spartanburg, SC, 29301, (864)597-4624; Patricia Cox, Division of Biology, University of Tennessee, 301 Hester Hall, Knoxville, TN 37996, (423)974-6225, pbcox@utkux.utccc.utk.edu; George Cline, Department of Biology, Jacksonville State University, Jacksonville, AL, 36265, (256)782-5798.

Research Awards Committee - Faculty: Chair: Robert Haynes, Department of Biology, University of Alabama, Tuscaloosa, AL 35487, rhaynes@biology.as.ua.edu (205)348-1829; Walter Diehl, Mississippi State University, Drawer G4, Mississippi State, MS 39762-5759 (601)325-7579, Tom Wentworth, Department of Biology, North Carolina State, Box 7612, Raleigh, NC 27695-7612, (919)515-2168, Tom_wentworth@ncsu.edu.

Research Awards Committee - Student: Chair: Paul A. Schmalzer, Mail Code DYN-2, Dynamac Corporation, Kennedy Space Center, FL 32899, (407)853-3281, Paul.Schmalzer-1@pp.ksc.nasa.gov; Lew Stratton, Dept. of Biology, Furman University, Greenville, SC 29613; Scott Franklin, Department of Biology, University of Memphis, Memphis, TN 38152-6081, (901)678-5539, sfrankli@memphis.edu.

Resolutions Committee: Chair: Whit Gibbons, Savannah River Ecology Laboratory, Drawer E, Aiken, SC 29802, (803)725-3533, gibbons@srel.edu; Robert George, Biological Sciences, Wilmington, NC 28403-3297, (910)962-3487, georger@uncwil.edu;

Terry Richardson, Department of Biology, University of North Alabama, UNA Box 5212, Florence, AL 35632-0001, (205)760-4429.

Patron Member and Exhibitor Committee (3 years): Chair: Ken McLeod, Savannah River Ecology Laboratory, Drawer E, Aiken, SC 29802 (803)725-3533; Vice-Chair: Dwayne Wise, Department of Biology, Mississippi State University, Drawer G4, Mississippi State, MS 39762-5759 (601)325-7579, daw@ra@msstate.edu; Bob Haynes, Department of Biology, University of Alabama, Tuscaloosa, AL 35487, (205)348-1829, rhaynes@biology.as.ua.edu; Past-Chair Local Arrangements: Kim Tolson, Biology Department, Northeast Louisiana University, Monroe, LA 71209, bitolson@alpha.nlu.edu

Enrichment Fund Board: Chair: (3 yr. appt.)Members of the Executive Committee and Finance Committee comprise the Enrichment Fund Board.

Editor's Report

Volume 44 of the ASB Bulletin had 210 pages with twelve book reviews and 307 abstracts of papers and posters presented at the annual meeting.



Officers of the Association of Southeastern Biologists. Front row, left to right: Joe Pollard, Whit Gibbons, Pat Cox, Pat Parr, Gerhard Kalmus, and Andy Ash. Second Row: Doug Rayner, Eloise Carter, Dwayne Wise, Robert Haynes, Terry Richardson, and Ken Shull.

1999 MEETING OF THE ASSOCIATION

CALL FOR PAPERS
THE 60TH ANNUAL MEETING
HOST: UNIVERSITY OF NORTH CAROLINA
AT WILMINGTON
MEETING SITE: WILMINGTON, NC
DATE: 14-17 APRIL 1999

NOTE WELL!

This will be the only call for papers.

Please note the following deadlines which are to be met before our 58th Annual Meeting hosted by Northeast Louisiana University.

- 22 November** Titles and abstracts of papers and posters (use blue abstract form). This will be the *only* call for papers. They must reach the program chairman by this date.
- 15 October** Nominations for ASB officers and executive committee.
- 15 November -
2 February** Submissions for research awards.
- 2 February** Application for student travel awards.

NOTICE

ASB and the Local Committee wish to encourage greater use of posters as an effective means of presentation. All posters will automatically be entered in a judging for a \$300 prize. Please consider whether your presentation could be given in the form of a poster. All posters will have the following dimensions: three feet wide and six feet high. Posters will not be pinned nor taped. Special adhesive will be provided to back posters.

**PAPER & POSTER SUBMISSION FORMS FOR 1999 MEETING
DEADLINE: 22 November 1998**

**Individuals presenting papers or posters are expected to be
members of ASB!**

This form, along with the original (blue) and one photocopy of the abstract should be addressed to the Program Chairman, Dr. Frank Schwartz, Institute of Marine Science, 3431 Arendell St., Univ. of North Carolina, Morehead City, NC 28557-3209. Forms must be received no later than **22 November 1998** for the title to appear on the program and the abstract to be published in the April 1999 ASB Bulletin. In the event of a last-minute absence, notify Dr. Schwartz at the above address or by phone, (252)726-6841 ext. 139, fax (252)726-2426.

Please type or print carefully. Provide the phone/fax numbers and e-mail address for the primary author only.

1.	Author(s):	
2.	Institution(s):	
3.	Phone: ()	Fax: ()
4.	Title (omit higher taxa--see No. 8 below):	

5. **Check:** ☐ Paper or ☐ Poster See notice on previous page. Further instructions will appear in the January *ASB Bulletin*.

6. **PROJECTION EQUIPMENT:** ☐ 35 mm slides, ☐ Overhead
 ☐ Other (specify): _____

Time limit for presentations and questions is 15 minutes. Plan on speaking for 10-12 minutes to leave time for questions.

7. **Recommended Section:** Check appropriate section(s) to which your paper/poster should be assigned. If you check more than one, rank sections as to your preference (with "1" being first preferred). Indicate **Higher Taxon** to help program committee in arranging papers (omit these from the title unless necessary). Paper sections will be established based on needs. Posters will be grouped by subject area.

☐ Animal ecology ☐ Animal physiology ☐ Aquatic/wetland ecology ☐ Cell/Molecular biology ☐ Cryptogamic botany	☐ Cytology/Genetics ☐ Developmental biology ☐ Evolution ☐ Fish biology ☐ Ichthyology/Herpetology ☐ Invertebrate zoology ☐ Mammal biology	☐ Microbiology ☐ Parasitology ☐ Plant ecology ☐ Plant physiology ☐ Plant systematics ☐ Teaching biology
Other:		

8. **Abstract:** Since abstracts will be reproduced in the April *ASB Bulletin* by photo-offset, it is critical that abstracts be typed carefully in the box on the blue form, following the directions in detail. **Please use Roman, New Roman, CG Times or Times Roman 12 point font. Do not use a dot matrix printer.** Additional copies of the form may be obtained from the Editor: Dr. J. K. Shull, email: shulljk@appstate.edu; phone: 828-262-2675; fax: 828-262-2127. **Please follow the directions on how to present your abstract, otherwise your abstract may not be included in the *ASB Bulletin*.**
9. **NOTE:** If you wish to be notified of the day and time of your presentation, please include a self-addressed, stamped post card with this Title Sheet. Indicate title, your name, and leave a blank for day and time.
10. **Awards:** If you intend to submit an abstract and manuscript, please select from the following categories (see this *ASB Bulletin* for instructions; some require a manuscript. All posters will automatically be considered for the Poster Award (\$300.)
- ☐ ASB Student Research Award (\$600)
 ☐ ASB Faculty Research Award (\$600)
 ☐ Odum Award (\$250)
 ☐ Aquatic Biology Student Award (\$100)
 ☐ NC Botanical Garden Award (\$100)
 ☐ SEASIH Ichthyology Award (\$100)
 ☐ SEASIH Herpetology Award (\$100)
11. Reprints of abstracts are not available. You may duplicate the printed abstracts from the *ASB Bulletin*.
12. **Important:** In case of error in your name or title when printed or questions about your presentation, please notify the Program Chair, Dr. Frank Schwartz, as soon as possible – not the moderator of your paper session.

GUIDELINES FOR POSTER SESSION AND ASB POSTER AWARD (\$300)

Poster sessions have been incorporated as a regular means of scientific presentation at the annual ASB meetings. This type of presentation provides a more informal environment that encourages a direct interchange of ideas and discussion between presenter and audience. In order to stimulate greater use of posters as an effective means of presenting research results, ASB awards a \$300 cash prize to the best poster presentation. All posters will automatically be entered in a judging for the Poster Award. Adherence to the following guidelines will help ensure the effectiveness of the poster presentation and consideration for the award.

- (a) Posters must fit in an area 3 feet wide and 6 feet high. Posters will not be pinned nor taped. Special adhesive will be provided to place posters.
- (b) Posters must be displayed from 10:00 a.m. Thursday through 5:00 p.m. Friday. Authors will be required to be present at specified times during the annual meeting.
- (c) Posters should be carefully planned to maximize clarity and simplicity in conveying information.
- (d) Poster should have a heading including a title, author, and author's institution(s). This heading should be placed at the top in letters no less than 3 cm high.
- (e) The body of the poster, including text, figure legends and table captions, should be in type no smaller than 18 pt. (3-4 mm) and *must* be legible from a distance of about 1-2 meters.
- (f) The body should be self-explanatory and should include figures, tables, graphs, maps, or photographs displayed in a well organized, coherent, and easy-to-follow sequence from top to bottom. Each illustration should contain a caption. *Do not over crowd the display.*
- (g) A limited degree of text may be included, but care should be taken not to overwhelm the audience.
- (h) A large, abbreviated version of the abstract should be presented at the top of the poster, but below the heading. A clear listing of specific conclusions should appear at the bottom or end of the presentation.
- (i) In addition to adherence to the above listed guidelines, poster presentations will also be judged using the following specific criteria:
 - (i) overall aesthetics and attractiveness of presentation.
 - (ii) ease of reading from a distance (1-2 meters).
 - (iii) clear and concise organization.
 - (iv) clearly stated hypothesis.
 - (v) soundness of methods for testing hypothesis.
 - (vi) how well conclusions are supported by results

Further inquiries may be directed to the chair of the ASB Poster Award Committee: Dr. Michael E. Held, Department of Biology, Saint Peters College, Jersey City, NJ 07306, (201)915-9187

**NOMINATION FOR ASB OFFICERS AND EXECUTIVE
COMMITTEE POSITIONS**

DEADLINE: 15 OCTOBER 1998

To members of the Nominating Committee: I wish to suggest that you consider the following ASB member(s) in selecting nominees for officers and executive committee positions. (Please include the institutional address of each nominee.)

PRESIDENT-ELECT _____

VICE-PRESIDENT _____

TREASURER _____

EXECUTIVE COMMITTEE
(two will be elected for three-year terms.)

MAIL To:
Dr. Jim Fralish, Department of Forestry, Southern Illinois University,
Carbondale, IL (618)-453-7466; fralish@siu.edu

NAME & ADDRESS OF NOMINATOR _____

"TRAVEL" SUPPORT AWARDS FOR GRADUATE STUDENT MEMBERS OF ASB

DEADLINE: 2 FEBRUARY 1999

Limited funds are available to partially defray the expenses of graduate students attending the Annual Meeting. The awards are for lodging and meals only. Departments are urged to provide transportation for their graduate students. *Recipients must be members of ASB.* The guidelines for application are as follows:

- (a) *The recipient is a current member of ASB.*
- (b) The recipient must be presenting a paper or poster at the Annual Meeting and must include a copy of the abstract of the paper or poster to be presented.
- (c) The recipient must be currently enrolled as a graduate student in the department where he/she conducted this research.
- (d) Give a conservative, itemized estimate of meeting expenses including transportation. Student travel awards are granted on a competitive basis. Applicants must document expected expenses and list other sources of financial support for this meeting, including institutional aid, shared lodging and shared transportation.
- (e) In a paragraph, give a brief history of your education to date; indicate how many years you have been in graduate school and the expected date of completion of work for the degree, your major field of study and research, publications including those in press and in preparation, degree sought, name of major professor and any other pertinent details.
- (f) Give your source(s) of support while in graduate school; e.g. NSF, NIH, USDA, Teaching Asst., Research Asst., etc.
- (g) Include a letter of recommendation for an ASB support award from your faculty research advisor. This letter should comment on the work being presented and indicate the financial need of the student presenter. It should also indicate whether any departmental or other funding is available to the student.
- (h) Send application, with supporting letter, all in triplicate, to: Dr. Gary Walker, Department of Biology, Appalachian State University, Boone, NC 28608, (704)262-2672
- (i) Applicants will be notified of the decision of the Committee as soon as is practical. Recipients of the award will receive their checks at the meeting.

MERITORIOUS TEACHING AWARD NOMINATION

Deadline: 1 February 1999

Each year, the ASB recognizes one of its members for especially meritorious teaching. This award of \$1,000 is sponsored by Carolina Biological Supply Company, Burlington, North Carolina. The recipient will be announced at the 1999 Annual Banquet.

The recipient must be a member of ASB who is active in or recently retired from teaching and who has taught biology in a southeastern institution for at least ten years. The recipient is not limited to professors from institutions with graduate studies, but may be from any southeastern college or university.

The Award is for meritorious teaching. Among evidence of the qualification of the candidate are the recognition by his/her institution (especially in effective teaching and/or with teaching awards), and the number and quality of students for whom he/she has provided the primary inspiration to continue with a career in biology or to seek advanced education in a field of biological science.

Members are urged to nominate an outstanding teacher for this award, using the following form and to include a letter of nomination with supporting documentation (biographical sketch or CV, supporting letters, etc.). Supporting letters for nominees should be sent to the nominator, not to the selection committee. Past unsuccessful nominees may be reconsidered when renominated and additional up-to-date materials are provided. Nomination materials of unsuccessful nominees will be returned to the nominator. Send nomination and compiled materials to: Dr. Robert McGuire, Station 6463, Biology-Chemistry Department, University of Montevallo, Montevallo, AL 35115.

NOMINATION -- ASB MERITORIOUS TEACHING AWARD, 1999

NAME:

ADDRESS:

TEACHING INTERESTS:

NOMINATOR NAME/ADDRESS:

Supporting documentation:

(enclosed, in triplicate __)

curriculum vitae

letter of nomination

supporting letters

additional information (list)

RESEARCH AWARDS

ASB STUDENT RESEARCH AWARD (\$600) AND ASB SENIOR RESEARCH AWARD (\$600)

Given for an especially meritorious manuscript presented orally by the author(s) at the Annual Meeting. In order to qualify for presenting the paper, the author(s) must submit an abstract by the November deadline. Papers submitted for the competition must be received in triplicate and in their entirety by the January deadline and must be journal-ready manuscripts worthy of publication. The student award is given to the senior author if she/he is a graduate or undergraduate student at the time of presentation. To qualify, author(s) must submit an abstract, title form, and application for the award by 22 November 1998, and four copies of the journal-ready manuscript with abstract, title form, and short biographical sketches of each author by 29 January 1999. Only ASB members are eligible. Papers may be in press, but not published prior to the previous annual meeting. Judges will use a standard evaluation form that includes the following criteria: significance of ideas, soundness of hypotheses, originality (creativity), quality of methodology, validity of results, soundness of conclusions, clarity, completeness, organization, and contribution to the field. At the discretion of the Research Award Committees, the award may be withheld or it may be split in the case of a tie. Papers may be in press, but not published prior to the previous annual meeting.

Committee chairs:

- Senior** Chair: Robert Haynes, Department of Biology, University of Alabama, Tuscaloosa, AL 35487, (205)348-1829, rhaynes@biology.as.ua.edu
- Student** Chair: Paul A. Schmalzer, Mail Code DYN-2, Dynamac Corporation, Kennedy Space Center, FL 32899, (407)853-3281, Paul.Schmalzer-1@pp.ksc.nasa.gov

ASB STUDENT RESEARCH AWARD IN AQUATIC BIOLOGY (\$200)

Sponsored by Wildlife Supply Company (WILDCO), the purpose of the award is to encourage excellence in aquatic biology research by undergraduate and graduate students. Students who are members of ASB and whose work is sponsored by a professional biologist who is also an ASB member are eligible. The paper must be based on research designed and completed by the student and it must be presented orally by the student as senior author at the Annual Meeting. To be eligible, author(s) must submit an abstract, title form, and application for the award by 15 November 1998, four copies of the journal-ready manuscript with abstract, title form, and short biographical sketches of each author by 29 January 1999 and a letter from the sponsor affirming student status at the time the research was completed and sponsorship of the student to the chair of the Student Research Award Committee. Judges will use a standard evaluation form that includes the following criteria: significance of ideas, soundness of hypotheses, originality (creativity), quality of methodology, validity of results, soundness of conclusions, clarity, completeness, organization, and contribution to the field. At the discretion of the Student Research Award Committee, the award may be withheld or it may be split in the case of a tie.

It is intended that aquatic biology be broadly interpreted. For example, research projects on aquatic organisms, wetland biota, and water quality are all eligible. Committee Chair: Paul A. Schmalzer, Mail Code DYN-2, Dynamac Corporation, Kennedy Space Center, FL 32899; e-mail Paul.Schmalzer-1@pp.ksc.nasa.gov

EUGENE P. ODUM AWARD (\$250)

Given by the Southeastern Chapter of the Ecological Society of America for the best ecological paper presented by a student. Undergraduate and graduate students are eligible and the student must be the sole or senior author. The paper must deal with a clearly ecological topic and should be presented in any of the following sessions: Aquatic Ecology, Plant Ecology, or Animal Ecology. One copy of the title and abstract should be sent to the Program Chair by November 15, and a second copy to Dr. Cliff Hupp, U.S. Geological Survey, National Center, Mail Stop 430, Reston, VA 20192, (703)648-5207, crhupp@usgs.gov.

ASB STUDENT RESEARCH AWARD IN AQUATIC BIOLOGY (\$100)

Sponsored by WILDCO, the purpose of the award is to encourage excellence in research in aquatic biology by undergraduate and graduate students. Students who are members of ASB and whose research is sponsored by a faculty member or biology professional who is also an ASB member are eligible. The paper must be based on research designed and completed by the student and the paper must be presented orally by the student as senior author in a regular paper session at the annual meeting. The manuscript must conform to the style and general content of peer-reviewed journals in the area of aquatic biology. It is intended that aquatic biology be broadly interpreted; for example, the research could involve an entomological project or an aquatic insect.

All students entering a paper to be considered for the award should send an abstract to the program chair by 15 November 1998 and a manuscript, in triplicate, to Chair: Paul A. Schmalzer, The Bionetics Corporation, Mail Code Bio-2, Kennedy Space Center, FL 32899, (407)853-3281, pauischmalzer-1 @ksc.nasa.gov

THE NORTH CAROLINA BOTANICAL GARDEN AWARD (\$100)

Given by NCBG (through the Southeastern Section of the Botanical Society of America and the Southern Appalachian Botanical Society.) This is awarded for a paper presented at the annual ASB meetings that best advances our understanding of the biology and conservation of the southeastern plants and thus contributes to the mission of the North Carolina Botanical Garden. Of special interest to the Garden are the rare plant species of the Southeast: why they are rare; how they interact with plants, animals, and their environment; and what can be done to ensure their survival. The paper may deal with a broad area including systematics, ecology and conservation. All individuals who are eligible to present at the ASB meetings are eligible for this award. They may be students, faculty or others. **Awards Committee Chair:** Dr. Peter White, Department of Biology, CB3280, University of North Carolina, Chapel Hill, NC 27599.

**SOUTHEASTERN DIVISION OF THE
AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS
OUTSTANDING STUDENT PAPER AWARDS
ICHTHYOLOGY PAPER (\$100); HERPETOLOGY PAPER (\$100)**

These awards are given for the outstanding papers in the disciplines of ichthyology and herpetology presented by student members of the Southeastern Division of the American Society of Ichthyologists and Herpetologists (SEASIH.) Both undergraduate and graduate students are eligible, provided they are sole or senior author and the paper clearly deals with a topic concerning ichthyology or herpetology. To be considered submit title and abstract to the ASB Program Chair by 15 November 1998 A second copy should be sent by the same date to the SEASIH President: Dr. Floyd Scott, Department of Biology, Austin Peay State University, Clarksville, TN 37044. Winners will be announced at the ASB banquet.

NOTE: A limited number of "travel" grants (\$50 each) are available to selected student members of SEASIH who will be presenting papers or posters in ichthyology or herpetology at the annual ASB meeting. Students seeking travel awards should provide a brief justification for their request by 1 February 1999 to Dr. Floyd Scott at the address above.



OBITUARY

DR. WALTER SAMUEL FLORY, Jr.

Dr. Walter S. Flory, Jr., Babcock Professor Emeritus at Wake Forest University, was born on October 5, 1907 in Bridgewater, VA., and died on June 8, 1998 at the age of 90 in Winston-Salem, NC.

Walter was an outstanding student. After graduating from Bridgewater College in 1928, he entered the University of Virginia as a Blandy Fellow. He earned an A.M. (1929) under William A. Kepner in one year and a Ph.D. in Biology (1931) under Orland E. White in another two years — at the age of 23. He enjoyed a year of post-doctoral work (1935-36) at Harvard as a National Fellow and Research Associate in Biological Science. He was elected to Phi Beta Kappa, Phi Sigma, Tau Kappa Alpha and Sigma Xi.

An outstanding geneticist, botanist and educator, Dr. Flory served well at several institutions: 1931-32, Charge of Technical Work for Shaver Bros. Inc.; 1932-34, Instructor of Science at Greenbrier Jr. Coll.; 1934-35, Prof. of Biology at Bridgewater Coll.; 1936-44, Horticulturist at Texas Agricultural Experimental Station (Tex. A&M); 1944-47, Horticulturist at Virginia Agricultural Experimental Station (V.P.I.); 1945-48, Collaborator with the US Dept. of Agriculture; 1947-63, Prof. of Experimental Horticulture at U.Va., and Vice Director and Manager of the Blandy Experimental Farm; 1955-63, Curator of the O. E. White Research Arboretum; 1964-76, Director of Reynolda Gardens; 1969-72, President of Highlands Biological Station; 1972, Research Consultant for Fairchild Tropical Garden; 1963-80, Babcock Prof. of Botany at Wake Forest University.

Dr. Flory significantly contributed to research in the fields of genetics and cytology of horticultural plants; adaptability, phylogeny, breeding and cytology of woody ornamentals; cytotaxonomy of Amaryllidaceae; and gamma radiation of woody plants. From 1930 through 1998 he contributed over 150 articles in professional journals and over 100 popular articles in sectional and national magazines. Dr. Flory's students were Dr. Thelma F. Schmidhauser, Dr. Smritomoy Bose and Dr. Raymond O. Flagg at U.Va., and Dr. Lorraine B. Spencer (deceased), Dr. Francis F. Willingham, and Dr. Dwight Kincaid at Wake Forest. Dr. Gerald L. Smith was a Research Associate with Dr. Flory at Wake Forest.

Dr. Flory was an active and valuable member to our Association for 49 years. He joined the ASB in 1949. He presented a paper at the next annual meeting and numerous meetings thereafter. He was a very active in the ASB, and he — an example for us all — also expected his students to attend the annual meetings and to present papers. Besides serving on various ASB committees, he was elected Executive Committee Member (1956-59), Vice President (1960-61), and President (1962-63). In 1978 Dr. Flory won the ASB Research Prize. For the 50th anniversary of the Association, he (1987) wrote *A 50-Year Historical Perspective 1937-87 of the Association of Southeastern Biologists*, ASB Bulletin 34 (2, Supplement): 1-21. And finally, he co-authored a paper presented by two former students at the 1998 ASB meeting.

Dr. Flory's contributions to other professional organizations include: Am. Assn. Bot. Gardens and Arboreta (Editorial Bd. 1962-64); Am. Boxwood Soc. (Co-

founder, Treas., Editor, Director 1961-63); Am. Magnolia Soc. (VP 1968-79); Bot. Soc. of Am. (Chrm. Southeastern Sect. 1951-52); So. Appalachian Bot. Club (VP 1962); Va. Acad. of Sci. (Pres. 1956).

Among many honors he was AAAS Fellow, and was elected an honorary life member in Am. Begonia Soc., Am. Boxwood Soc., Fairchild Tropical Garden, Friends of Blandy, La. Soc. Hort. Research, and Va. Academy of Sci. Other honors bestowed upon him include: J. Shelton Horsley Research Award, Va. Academy of Sci. (1949); President and Visitors Research Prize, U.Va. (1951); Sc.D., Bridgewater College (1953); Alumni Award, Bridgewater College (1956); I. F. Lewis Distinguished Service Award, Va. Academy of Sci. (1969); Special Citation, Highlands Biological Station (1973); Herbert Medal, American Plant Life Society (1978); Outstanding Service Award, Bridgewater College (1981).

Dr. Flory's involvement and recognition exceeded national boundaries. He was a delegate to the International Botanical Congress in Paris (1954), in Montreal (1959), in Edinburgh (1964), in Seattle (1969) and in Sydney (1981). He was a member of the International Genetics Congress in Montreal (1958) and in Tokyo (1968). He was a member of the International Horticultural Congress in College Park, Md. (1966) and in Sydney, Australia (1978). He was an invited lecturer at the International Seminar on Chromosomes in Calcutta (1968 and 1976). He was also honored as a Bicentennial Fellow of the Royal Horticultural Society.

In the passing of Walter S. Flory, Jr. the ASB has lost one of its most able, loyal and enthusiastic members. Maude Thomas Flory, his wife for 41 years, died in 1971. He is survived by his wife, Gale Crews Gramley Flory, whom he married June 25, 1975; a daughter, Kathryn F. Maier; two sons, Walter S. Flory, III and Thomas R. Flory; two stepsons, David I. Gramley and Dale H. Gramley; four grandchildren and three great grandchildren.



Dr. Walter S. Flory, Jr. (left) receiving 1978 ASB Research Medallion from Dr. Thomas E. Powell, Jr. (deceased Dec. 3, 1987), founder of Carolina Biological Supply Co.

THE CENTER TWO PAGES OF THIS ISSUE
CONSTITUTE A POSTER THAT YOU CAN
REMOVE. PLEASE POST THIS ANNOUNCEMENT IN
YOUR DEPARTMENT. FEEL FREE TO PHOTOCOPY IT
AND PLACE SEVERAL ANNOUNCEMENTS IN
VARIOUS PLACES. BY DOING THIS YOU CAN HELP
BUILD INTEREST IN ASB.

RESEARCH AWARDS

TO BE PRESENTED AT THE
ANNUAL MEETING OF THE

ASSOCIATION OF SOUTHEASTERN
BIOLOGISTS

APRIL 14 - 17 1999

UNIVERSITY OF NORTH CAROLINA AT WILMINGTON
WILMINGTON, NC.

◆ ASB STUDENT RESEARCH AWARD	\$600
◆ OUTSTANDING POSTER	\$300
◆ WILDCO STUDENT RESEARCH AWARD IN AQUATIC BIOLOGY	\$200
◆ EUGENE P. ODUM AWARD (BEST ECOLOGY PAPER PRESENTED BY A STUDENT) .	\$250
◆ THE NORTH CAROLINA BOTANICAL GARDEN AWARD	\$100
◆ SOUTHEASTERN DIVISION OF THE AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS OUTSTANDING STUDENT PAPER AWARDS ICHTHYOLOGY PAPER	\$100
HERPETOLOGY PAPER	\$100

SUBMIT YOUR PAPERS BY THE DEADLINES
LISTED IN THIS ISSUE OF THE
ASB BULLETIN

New Committee

At the April Annual Meeting the Poster Committee was established as a standing committee. The description and duties of the committee are as follows:

Poster Committee Duties

1. The Poster Committee shall consist of three (3) members appointed for terms of three years, with a member appointed annually by the President and serving as Chair in the third year. The Poster Committee shall be responsible for the following activities.
2. Solicit poster presentations for the annual meeting by an announcement in the Call for Papers (to editor by June 1). In addition, the following statement and guidelines should be announced in the September (to editor by July 1) and January (to editor by October 1) issues of the Bulletin.

Guidelines for Poster Session and ASB Poster Award (\$300)

Poster sessions have been incorporated as a regular means of scientific presentation at the annual ASB meetings. This type of presentation provides a more informal environment that encourages a direct interchange of ideas and discussion between presenter and audience. In order to stimulate greater use of posters as an effective means of presenting research results, ASB awards a \$300 cash prize to the best poster presentation. All posters will automatically be entered in a judging for the Poster Award. Adherence to the following guidelines will help ensure the effectiveness of the poster presentation and consideration for the award.

- **
- (a) Display should fit on a 4' h x 8' w board suitable for thumbtacks or pushpins.
 - (b) Posters must be displayed from 10:00 a.m. Thursday through 5:00 p.m. Friday. Authors will be required to be present at specified times during the annual meeting.
 - (c) Posters should be carefully planned to maximize clarity and simplicity in conveying information.
 - (d) Poster should have a heading including a title, author, and author's institution(s). This heading should be placed at the top in letters no less than 3 cm high.
 - (e) The body of the poster, including text, figure legends and table captions, should be in type no smaller than 18 pt. (3-4 mm) and *must* be legible from a distance of about 1-2 meters.
 - (f) The body should be self-explanatory and should include figures, tables, graphs, maps, or photographs displayed in a well organized, coherent, and easy-to-follow sequence from top to bottom. Each illustration should contain a caption. *Do not over crowd the display.*
 - (g) A limited degree of text may be included, but care should be taken not to overwhelm the audience.

** ***See changes for this year only on page 154.***

- (h) A large, abbreviated version of the abstract should be presented at the top of the poster, but below the heading. A clear listing of specific conclusions should appear at the bottom or end of the presentation.
 - (i) In addition to adherence to the above listed guidelines, poster presentations will also be judged using the following specific criteria:
 - (i) overall aesthetics and attractiveness of presentation.
 - (ii) ease of reading from a distance (1-2 meters).
 - (iii) clear and concise organization.
 - (iv) clearly stated hypothesis.
 - (v) soundness of methods for testing hypothesis.
 - (vi) how well conclusions are supported by results

Further inquiries may be directed to the chair of the ASB Poster Award Committee: Name, address, phone number, and e-mail address of Poster Committee Chair.

3. The Poster Committee shall convene at the Annual Meeting to review and scrutinize each poster presentation and select an especially meritorious poster for the award. Committee members are expected to be reviewers and may seek additional reviewers. It is expected that committee members will not enter into a conflict of interest in judging posters. A reviewer's score sheet with a rating scale in several categories may be used by the reviewers and committee members. Every effort should be made to keep the identity of the award recipient confidential until the announcement of the winner has been made.
4. A poster award need not be given if there is not a meritorious poster presented.
5. Before the banquet and announcement of the winner, the Chair should notify the Treasurer of the winning poster so the check can be prepared. The Chair should also provide the name and address of the winner to the person in charge of the award plaques before the close of the annual meeting so that a plaque can be mailed to the winner.
6. Prepare a citation for the poster award to be presented by the Committee Chair at the Annual Banquet.
7. Following the annual meeting, the Chair should prepare an annual report and send it to the new President and the Archivist due May 1.

Beta Beta Beta Papers and Posters Given at the 1998 Annual Meeting

District I

Brooks Award — First Place

MAHAR, SUSAN, East Tennessee State University, Effects of Various Agents and Drugs on the in-vitro Biosynthesis of Phosphorylated tau.

Phosphorylated tau is a normal brain protein that has been shown to be specifically associated with Alzheimer's disease in three separate studies using post mortem brain tissue. Tau protein is a microtubule binding protein that is regularly involved in the control of microtubule assembly. In Alzheimer's disease a phosphorylated version of tau accumulates and is likely involved in cellular death. The effect on tau synthesis of agents that either stimulate or inhibit the enzymes responsible for tau phosphorylation was measured using both mouse and human brain tissue. These agents included drugs and metals that are known to alter the activity of the kinases or phosphatases responsible for control of tau phosphorylation. This research should help elucidate the mechanisms responsible for control of phospho-tau synthesis. Understanding the biosynthesis of the tau may lead to methods of controlling either the cause or spread of Alzheimer's disease within the brain tissue of victims.

Brooks Award — Second Place

Roling, Jonathan A. Erskine College. Fragmented Habitat Requirements of the Eastern Box *Terrapene C.*

The Eastern Box Turtle (*Terrapene carolina carolina*) is a species under increasing pressure from habitat destruction. More commonly, turtles are forced to live not on large tracts of undisturbed forest, but on forest fragments squeezed between "developed" areas. The fragmentation of an environment not only decreases individual turtle space but also limits their accessible microhabitat diversity, affects their behavior, and reduce the genetic diversity. To understand the critical requirements for an island environment, we focused on hibernation, feeding, nesting, and hatchling survival during the crucial first year. Artificial sand nesting sites were added to the property to aid in egg laying. Two nests were located this year, and both produced hatchlings. Radio telemetry was used to located nine turtles on a 20 acre wooded lot in the city of Mauldin, SC. Their positions were mapped to a grid system and linked with four previous years of study. Home range sizes were calculated for each of the turtles and used for analysis along with other turtle's home ranges. The box turtle is an important indicator of a healthy eastern woodland environment. The long term goal is the conservation of the Eastern Box Turtle.

Brooks Award — Third Place

MILLER, JUSTIN. Catawba College, Salisbury, NC. The Kinetics of Pseudohyphal Growth of Yeast.

The yeast, *Saccharomyces cerevisiae* usually divides by budding while the yeast *Schizosaccharomyces pombe* usually divides by fission. When grown on complete medium, these yeast produce round colonies with smooth margins with an Euclidean dimension of 1. On nitrogen-limited medium the yeast change from their normal cell division to pseudohyphal growth. Pseudohyphae are chains of cells that fail to separate after the division. This pseudohyphal growth causes an irregular perimeter with a fractal dimension of about 1.2. I examined the change of fractal dimension growth in these yeast. Digital images of yeast colonies were made every 4-8 hours and the fractal dimension of colony perimeters was determine with the program Fractal-D. Using the integrated rate law zero, first and second order fits were performed to determine the growth order. Linear fits were found for both the first and second order graphs. Further experiments are needed to give an unambiguous determination of growth order.

Hand, Valerie K., Raymond E. Kuhn. Wake Forest University -- Interleukin-4 antibody does not confer resistance. to cestode infection in mice.

Infection of mammals with cestode larvae is animal cystericercosis. An experimental modal of this system uses Balb/c mice infected with *Taenia crassiceps* larvae. T cells secrete the cytokines Interleukin 4 (IL-4) and interleukin-10 (IL-10) in response to cestode parasites. These cytokines result in the humoral mediated, T-helper cell 2 (Th2) response which seems to be ineffective in fighting this parasitic infection. A T-helper cell 1 (Th1) response activates cytotoxic T cells and natural killer cells, which may be more successful against parasitic infections. This study attempted to redirect the immune system toward a Th1 response by injecting *T. crassiceps* infected mice with monoclonal antibody against IL-4 during the first 30 days of infection. Results did not show a significant decrease in parasitic numbers or IL-4 levels in the mice injected with anti-TL-4. These results suggest that injecting mice with anti-IL-4 during the first 30 days of a *T. crassiceps* infection does not provide additional resistance to this parasite.

McELVEEN, MELINDA R. Wake Forest University -- Visitation of Adult Lepidoptera (Arctiidae) to a Pyrrolizidine Alkaloid-Containing Plant *Eupatorium capillifolium*.

Previous observations have indicated that some species of Lepidoptera are attracted to dying, withering plants known to contain pyrrolizidine alkaloids. These adult insects generally collect the chemicals from the roots or stems of the plants. In some moth species, this visitation is male-biased; in others, it is female biased, and in some species, both male and females visit. Studies were done to discover the species and sex of adult Lepidoptera attracted to the roots of *Eupatorium capillifolium*, an herbaceous weed know more commonly

as dog fennel. This study was conducted at Archbold Biological Station in south central Florida. Five species of arctiid moths were found to visit the decomposing roots of *Eupatorium capillifolium*. Visitations to these plants was predominantly male-biased, though in one species visitation was exclusively female.

CRANE, TIFFANY E. Loyola University — The effects of habitat on vertical accretion on natural crevasse splays at Delta National Wildlife Refuge.

Sedimentation processes of accretion and subsidence contributing to wetland formation and loss on two different lobes of the Brant Pass splay of the Mississippi River were analyzed as the beginning of a three year study to assess the role of different habitat types in wetland formation and maintenance- Each lobe of the splay is characterized by four plant communities (White 1983) linearly juxtaposed on a downward gradient of elevation along the lobe's long axis. A *Salix nigra* community grows on the highest land followed by communities of *Scirpus deltaeum* and *Sagittaria* spp. (*S. latifolia* and *S. platyphylla*), with an open mudflat or pioneer community at the lowest elevation. To identify the contributing factors effecting wetland formation and maintenance, records of several variables were made at each of the communities plus an open water site. The range in mud surface elevation across all sites is 98.5 cm. Sediment deposition varied greatly between sites (mean=-3.4 cm). All sites had predominantly sandy sediment (mean=76.9% sand), mean silt = 8.3% and mean clay=6.8%. pH was about neutral. The average organic content based upon loss on ignition was 6.3%. Average moisture contents was 29.5%. Mean above ground biomass was 214.4 g/m² and the mean below ground biomass was 596.3 g/m².

B. BRAHNEY, C. MONROY+, A. RODAS, AND P. DORN*. *Loyola University, New Orleans, LA, USA, + University of San Carlos, Guatemala City, Guatemala. Detection of *Trypanosoma cruzi* and *Trypanosoma rangeli* in Vector Samples from Guatemala.

Trypanosoma cruzi is a parasite of importance as the causative agent of Chagas disease, a leading cause of heart disease in Latin America. The parasite is transmitted by the feces of Reduviid bugs. In Guatemala the predominant vectors are *Triatoma dimidiata* and *Rhodnius prolixus*. *T. cruzi* is usually detected by microscopy which presents a problem because many bugs also harbor the non-pathogenic but morphologically similar, *T. rangeli*. The PCR has been shown to be a sensitive alternative to microscopy in the detection *T. cruzi* although its utility in mixed infections (*T. cruzi* and *T. rangeli*) had not previously been assessed. 138 *T. dimidiata* and *R. prolixus* were collected in Guatemala and stomach, intestine and rectal samples were obtained and analyzed by microscopy then the PCR. Results showed that *T. cruzi* was detected in the presence of 95% *T. rangeli*, however *T. rangeli* could only be detected when it constituted 75 % of the sample. With these limits of detection *T. dimidiata* showed infection with *T. cruzi* in 25.7% or 35.7% of the bugs and *R. prolixus* showed in 22.4% or 53.71% by microscopy or PCR, respectively. *T. rangeli* was not detected in *T. dimidiata*, however 17.9% of *R. prolixus* showed infection by PCR (14.9%

mixed infections and 3.01% *T. rangeli* alone). Thus, in *R. prolixus*, the PCR was significantly more sensitive than microscopy.

District II

Brooks Award — First Place

SIKES, ELIZABETH M. Columbus State University -- Starch Gel Electrophoresis of blood proteins from *Gopherus polyphemus* and *Trachemys scripta scripta* acclimated to specific ambient temperatures along a thermal gradient in order to determine qualitative differences in isozymes in individuals.

Starch Gel Electrophoresis (SGE) is used as a means to determine underlying population genetic structure of various species. Despite behavioral thermoregulation, ectotherms withstand a broad spectrum of critical thermal minimum and maxima. It has been demonstrated that variations of enzymes which perform the same functions are important to adapting to a changing environments. Starch Gel Electrophoresis will be used to determine if either of two species, *Gopherus polyphemus* or *Trachemys scripta scripta*, will produce allelic variations of the same proteins after acclimation to particular temperatures along a thermal gradient. This data could have possible implications for population genetics studies using this method.

Brooks Award — Second Place

DULANEY, DOUGLAS, East Tennessee State University. Structural arrangement of the gene for an ANP-like peptide in plants.

Recently a protein similar to Atrial Natriuretic Peptide (ANP) was identified in plants. Preliminary evidence suggests this protein is involved in water/solute transport. Utilizing primers designed to amplify a 272 bp product from a *Geranium* cDNA, PCR analysis of total genomic DNA from *Geranium* and *Arabidopsis* revealed 2 products, 800 bp and 10,000 bp. Both genomic products are larger, suggesting the presence of introns in that region of the gene. Cloning, restriction enzymes mapping, and sequencing should distinguish which of these genomic products are related to the ANP-like peptide.

Brooks Award — Third Place

LINGO, ELIZABETH A. Columbus State University--Amplification and DNA fingerprinting for the detection of *Mycoplasma agassizii* in gopher tortoises with upper respiratory tract disease.

Upper Respiratory Tract Disease (URTD) is an emerging problem that threatens the survival of the Gopher Tortoise (*Gopherus polyphemus*) and the Desert Tortoise (*Gopherus agassizii*) both in the wild and in captivity. *Mycoplasma agassizii* is the known etiological agent responsible for URTD. The disease is characterized by an inflamed respiratory tract, wheezing, runny nose, and swollen eyes. It eventually leads to the death of the tortoises. Throughout the process of relocating tortoises many infected tortoises are moved, resulting in the spread of the disease. To this date the only test for the detection of the disease is the ELISA, which may take weeks to obtain results. The current study attempts to develop a specific, sensitive and rapid procedure that will create a DNA finger print of the bacterium *Mycoplasma agassizii* as a mean of diagnosis of Upper Respiratory Tract Disease in gopher tortoises. The method employed to create the DNA fingerprint is DNA amplification. External and nested primers that amplify the 16s rRNA gene will be utilized in different combinations to obtain products. Successful amplifications will be determined by visualization of electrophoresed, ethidium bromide-stained agrose gels. Current results are pending.

Brooks Award — Honorable Mention

Dr Patricia Dorn, Juan Flores Loyola University, New Orleans Detection of *Trypanosoma cruzi* parasites in Fecal Drops of *Rhodnius prolixus* Vector..

Chagas disease is the second leading cause of heart disease in Central and South America (WHO 1991). The disease is caused by the parasite *Trypanosoma cruzi* which is transmitted to humans by triatomine vectors including *Rhodnius prolixus*, a major vector in Central America. In addition, vectors are often infected with *T. rangeli*, a morphologically similar, but non-pathogenic, trypanosome. Polymerase Chain Reaction (PCR) has been proved to be an effective method of detecting *T. cruzi* infection in particular vectors. However, tissue samples obtained from the vectors are difficult to preserve so an alternative sample, vector fecal drops dries on filter paper, was examined for its usefulness in detecting *T. cruzi* infections. In this study, 105 *R. prolixus* vectors were collected on filter paper and submitted to similar test. The results of these two studies were compared in order to see whether the latter provided comparable detection rates. Approximately equal levels of infection were found in both types of samples, proving that dried fecal drops on filter paper can indeed be an effective method in detecting *T. cruzi* parasites in the host. In addition, the results also showed a high level of *T. rangeli* infections in this *R. prolixus* population.

NICKLES, JENNIFER and MARY JACOBS Jacksonville State University. Progress in Purification of Potato Tyrosinase.

Tyrosinases (polyphenol oxidase) are a class of oxoreductases that are broadly distributed in eukaryotes and are involved in amino acid metabolism. We are attempting to purify and characterize the tyrosinase(s) from tubers of the common potato. Crude potato extract is filtered and centrifuged. The resulting pellet of large cellular fragments is extracted with high salt and the insoluble material is centrifuged out. The supernatant, containing much of the tyrosinase activity but with greatly reduced contaminants, is fractionated by ion exchange followed by hydroxyapatite chromatography. Unlike mushroom tyrosinase, which is almost completely purified by these procedures, the potato tyrosinase fractions are still contaminated, especially by a prominent 45 kilodalton band. Additional chromatographic procedures, such as hydrophobic interaction or cation ion exchange chromatography, will be needed to purify potato tyrosinase to completion.

SAED ABDENNABI. Northern Kentucky University -DHEA (Dehydroepiandrosterone): its effect on fertility rates and fetal developments.

DHEA is a steroid hormone currently sold over the counter "to increase strength, to promote weight loss, and to return vitality to older individuals. It is not regulated by the FDA because it is being marketed as a food supplement, a category of chemicals not under FDA jurisdiction. Neither safety nor effectiveness have been proven. DHEA is the principal androgenic steroid produced by the adrenal gland. The effect of more potent androgens, such as testosterone, on female fertility has been documented, but virtually no work has been done in the area regarding DHEA, in spite of its now alarmingly widespread use. We have measured the fertility rate, weight gain/lose, and incidence of abnormal fetal development in female rats receiving 0 mg DHEA/g rat chow, 2.3 µg DHEA/g rat chow (manufacturer's recommended dose adjusted for rat weight, or 0.46 mg DHEA/g rat chow (200X manufacturer's recommendation). There were no differences in the weight gain/loss between the groups, however the 0.46 mg group experienced complete infertility, with no litters being born after three separate attempts at mating.

ELIZABETH MARKSBERRY. Northern Kentucky University-Impact of aircraft de-icers used at the greater Cincinnati International Airport on Gunpowder Creek and a bioassay study on biodegradation of the de-icers by *Sphaerotilus natans*.

In the past several years it has become know that aircraft de-icing from Greater Cincinnati/Northern Kentucky International Airport (GCIA) is having an environmental effect on gunpowder creek. This study involves the impact on the biota of Gunpowder Creek for the past two years. The results indicate a decrease in species diversity. A filamentous bacteria *Sphaerotilus* sp, Was found to thrive during time of de-icing. Microcosms were set up to explore the possibility that *Sphaerotilus* sp. Was actually aiding in the degradation of ethylene glycol based de-icers

Alexander, R., R, Midland, T- Pennick, M. Richardson, L, woods, and D. Buckalew. Dept. of Biology, Xavier Univ. of LA, New Orleans, LA. Incidence and lateral distribution of arbuscular mycorrhizae in soils in a freshwater wetland ecosystem

Arbuscular mycorrhizal (AM) associations are ubiquitous in terrestrial plant communities. Evidence for their occurrence in coastal and wetland habitats has concentrated mainly on studies of sand dune community dynamics. However, data from wetland community studies suggest the role of mycorrhizae in these areas is unclear. Their occurrence ranges from total absence to seasonal colonization due to such factors as seasonal drawdowns, oxygen availability, and plant root specialization. The goals of this study were to survey and assess the presence/abundance of VAN along a distance gradient from soils at water's edge to a distance of 30 meters from nearest standing water.

BALL, ELIZABETH N. East Tennessee State University--Isolation and Characterization of an Arabidopsis cDNA to an ANP-like Peptide.

Recently a plant protein similar to animal Atrial Natriuretic Peptide (ANP) has been identified. Preliminary evidence suggests this protein is involved with water/solute transport. Utilizing PCR, we have isolate the cDNA for this protein from an *Arabidopsis* root cDNA library. Primers designed from a *Geranium* cDNA were used to amplify a 3100 bp fragment. Restriction enzyme mapping and subsequent sequencing will enable us to compare this cDNA with known ANP sequences.

SPRINGATE, AMY. East Tennessee State University -- Effect of acidic conditions on amphibian growth during development.

Research on effects of pH is needed to determine whether acid deposition may contribute to declines in amphibian populations. The study evaluated the hypotheses that low pH had a direct effect on growth of embryonic and recently hatched frog larvae. Two frogs, *Rana sylvatica* (local) and *Xenopus laevis* (laboratory) were compared. Multiple experiments used a standardized bioassay (Frog Embryo Teratogenesis Assay - *Xenopus*) extended for 20 days by maintaining tadpoles in neutral pH. Four replicates each were used of a negative control (pH 7.4), two positive controls (6-aminonicotinamide), and five test solutions (pH 3.5, 4.0, 4.5, 5.0, 5.0) which used sulfuric acid to alter pH. Measurements of egg mass and diameter were obtained daily; after hatching, mass tail and body lengths were measured every two days. Data were analyzed (ANOVA) for effects of replicate, treatment, and age (days). Analyses show that pH negatively affected mass and body size ($P=0.0001$ for all) of embryos and larvae. A significant reduction in egg mass and diameter was detected in *Rana sylvatica* embryos aged 1 (as compared to day 0 or 2) that was not present in *Xenopus laevis*, suggesting that the local species may be more sensitive to effects of pH.

AUTHEMENT, STEPHANIE J. (Research Advisor: Dr. David White) Department of Biological Sciences, Loyola University -- Abundance and distribution of woody species in remnant bottomland hardwood forests of extreme southeastern Louisiana.

Intact bottomland hardwood forests are increasingly threatened by development and agriculture. In extreme southeastern Louisiana, only 8 relatively intact forest fragments remain. This study of the final two forests, completes the documentation of the abundance and distribution of woody species in these remnant forests. Using the quadrat sampling technique, importance values were calculated by summing relative dominance and relative density on both overstory (>10.00 cm DBH) and understory (3.00-9.99 cm DBH) components. The values were then compared to those of the other 6 forests. Soils were analyzed from all 8 forests for pH, percent moisture, loss on ignition (LOI), total nitrogen, total carbon and particle size. A total of 40 woody species were identified in the 8 forests. The most dominant woody species with the over story of the 8 forests are *Quercus virginiana*, *Celtis laevigata*, *Quercus nigra*, *Liquidambar styraciflua*, and *Ulmus americana*. The most dominant wood species within the understory of these forests are *Acer rubrum*, *Celtis laevigata*, *Ulmus americana*, *Quercus nigra*, and *Liquidambar styraciflua*. Community composition could not be definitively correlated to the differences in soil conditions among these forests. Multivariate ordination of the overstory showed two groups of forests, those dominated by *Quercus virginiana* and those dominated by *Celtis laevigata*.

Beta Beta Beta Posters

Johnson Award — First Place

VOGL, CATHERINE A. and OSVALDO DELBONO. Catawba College and Wake Forest University. Age-related Changes in Skeletal muscle L-type Ca²⁺ Channel and Ryanodine Receptor Gene Expression.

The dihydropyridine receptor (DHPR) and ryanodine receptor (RYR) are coupled to play an important role in the mechanism of skeletal muscle contraction. DHPR and RYR uncoupling results in reduced contractive force in aging skeletal muscle. In the DHPR, the β_1 subunit affects the expression of the α_1 subunit. We investigated alteration in DHPR, α_1 and β_1 subunit gene expression in mouse single extensor digitorum longus muscle fibers with aging. Reverse Northern Blot analysis of DHPR α_1 and β_1 subunit mRNA from seven, eighteen, and twenty-eight month old mice was utilized. As mice age, there is an increase in the mRNA expression of the α_1 subunit of DHPR. In addition, the coexpression of both subunits causes an increase in the calcium channel activity. The results showed that the increase in DHPR β_1 subunit mRNA expression is less pronounced than the increase of the α_1 subunit mRNA expression in middle age and old mice. Therefore an excess of the α_1 subunit is not functionally or biochemically detectable as mice age. This decrease in the expression of the DHPR results in decreased coupling with RYR leading to a decline in skeletal muscle force with aging.

Johnson Award — Second Place

Gandy, A. Dustin¹, S. Gasic, Y. Bodenbunrg, and R.J. Urban². University of North Alabama¹ and University of Texas Medical Branch² -- Troglitazone inhibits the proliferation in the NWTB3 cell line.

Insulin resistance is a major characteristic of type 2 diabetes and several other human disease states such as obesity, hypertension, and polycystic ovarian syndrome. Troglitazone, a thiazolidinedione derivative, increases insulin sensitivity in type 2 diabetes. To enhance insulin sensitivity, troglitazone regulates expression of genes involved in insulin action. Troglitazone is a high affinity ligand for the peroxisome-proliferator activated receptor (PPAR α), which upon activation forms a heterodimer with retinoic acid X receptor (RXR) and binds to gene promoters. By activation of this heterodimer troglitazone subsequently activates or represses transcription. The main effect of troglitazone on the cells of fibroblast origin is to induce their terminal differentiation towards adipocyte phenotype. Most connective tissue tumors or sarcomas have a fibroblast origin it is possible that troglitazone and related agents might induce differentiation and suppress cell growth. Previous studies indicated that thiazolidinediones may be useful proliferation inhibitors for the treatment of liposarcomas. Deregulation of cell cycle genes play a significant role in oncogenesis. The overactivation of positive cell division cycle regulator and/or inactivation of inhibitors favor tumor progression. The D cyclins are the major contributors for induction of a new cell cycle and have been heavily implicated in human cancer. As D cyclins increase, cyclin dependent kinases 4 and 6 are activated and phosphorylate retinoblastoma. This hyperphosphorylation of retinoblastoma allows for the release of transcription factors and stimulates S-phase entry. Thus, we studied whether troglitazone would inhibit NWTb3 cell proliferation and affect D cyclins expression by itself or in combination with RXR agonist 9-cis-Retinoic acid

SINGLETON, SHERVIA T, SOUTHERN UNIVERSITY -- EFFECTS OF SODIUM BUTYRATE ON HUMAN ERYTHROLEUKEMIA CELLS (K562 CELLS) IN RELATION TO SICKLE CELL DISEASE.

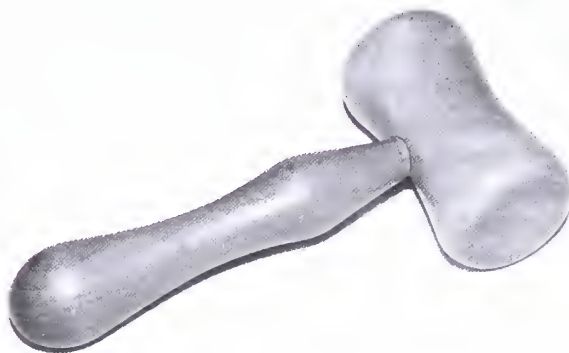
Sickle cell disease (SCD) is a detrimental genetic disease prevalent in Africans and African-Americans. It is characterized by hemolytic anemia caused by increase fragility of red blood cells (RBC), vasoocclusive pain crisis, increases susceptibility to bacterial infections, delayed physical growth, and premature death. Previous studies have shoe that the presence of large amounts of fetal hemoglobin prevents symptoms and the sickling of the RBC's (Bunn, 1993). Aliphatic butyrate salts, have been shown to increase fetal hemoglobin production in animals (Perrine et al. 1988, Constantoulakis et al. 1988) and in cultures of human erythroid progenitors (Perrine et al. 1989). The objectives of this study will be: 1) determine the long-term effects of sodium butyrate on K562 cells (human erythroleukemia cells) by exposing K562 cells to different pharmacological concentration of sodium butyrate (0.01, 0.1, 1 mM), the positive control hemin (25 mM and 100 mM), and cell culture media (90% RPMI 1640 +10% fetal calf serum + streptomycin + fungicide + 15 mM hepes + NaHCO₃ + heparin). The exposure will be place in a highly humidified 37° C cell culture incubator with 5% CO₂ for 24, 48, 72, 96, 120, 144, and 168 hours 2) determine the effects of sodium

butyrate on total hemoglobin and fetal hemoglobin levels in K562 cells by calorimetric analysis utilizing spectrophotometry and high performance liquid chromatography 3) determine the physiological effects of sodium butyrate on K562 cells by observing morphological changes using transmission and Scanning Electron Microscopy, The results of this

research will provide much needed knowledge that may lead to more effective treatment of sickle cell disease

VERRETT, PAMELA C. and PERPETUA M. MUGANDA. Southern University A & M College — Expression cloning of the human p53cDNA into an ecdysone inducible mammalian system.

The cellular protein p53 is classified as a tumor suppressor gene product. Alterations within the p53 gene is the most common genetic change found in cancer cells. Wild type p53 regulates normal cell proliferation by arresting the cell cycle in G1 phase. It also acts as a "molecular policeman" by accumulating in response to DNA damage and inhibiting proliferation while repair takes place. Constitutive expression of p53 causes cessation of cell growth making it difficult to obtain enough cells for experiments. In order to get around this problem, we have isolated the wild type and mutant p53 cDNA's from the pC53-Eco3 and pC53-Cx3 vectors, respectively. The p53 cDNA's have been recloned into the pIND inducible mammalian expression vector. Ten positive clones out of twenty resultant wild type colonies and ten positive clones of thirty-eight resultant mutant colonies were obtained. Both antisense and sense orientations were recovered. Preliminary results have shown that p53 is expressed as expected. These inducible p53 expressing plasmids will be used to study the role of p53 in Human cytomegalovirus mediated transformation process.



The ASB gavel made of yellow wood and sassafras.

REVIEWS

Dr. Frank Schwartz, Review Editor

Institute of Marine Science, 3431 Arendell St.

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Alcock, John. 1998. **Animal Behavior: An Evolutionary Approach.** 6th Edition. Sinauer Associates, Inc. Sunderland, MA. \$54.95. 640p.

To my knowledge, this is the ideal book for the student of animal behavior. In its sixth edition, it continues as the best text available on the subject. As the title suggests, Alcock emphasizes the role of evolutionary biology in explaining the ontogeny and phylogeny of behavior and presents an excellent synthesis of its underlying mechanisms. I think the book should be required reading for all biology and psychology majors, not just those enrolled in an animal behavior course. There are lots of others who would benefit from having a copy of this very helpful resource text on their shelves--veterinarians, neuroscientists, zookeepers, animal trainers, anthropologists, linguists and even physicians and lawyers.

The sixteen chapters are: An evolutionary approach to animal behavior (1), The proximate causes of behavior: analyzing communication (2), The development of behavior; the role of genes (3), The development of behavior: the role of the environment (4), The control of behavior: neural mechanisms (6), The evolution of communication: historical pathways (7), The evolution of communication: adaptation in signalers and receivers (8), Adaptive responses to predators (9), Adaptive feeding behavior (10), Choosing adaptively where to live (11), Male and female reproductive tactics (12), The evolution of mating systems (13), The adaptive tactics of parents (14), The adaptive value of social living (15); The evolution of human behavior (16).

I especially enjoyed the first chapter, not only from an historical perspective on ethology, but primarily because chapter one lays the proper foundation for the remaining chapters and the present day study of animal behavior. Chapters seven and eight on communication evolution were also well written and up-to-date. I think Alcock does a fine job discussing the co-evolution of signal and receiver but I wonder if he should have mentioned, somewhere, in these chapters Michael Ghiselin's observation that selection works not only on the signal but also on the receiver mechanism. Chapters 12 and 13 on reproductive tactics and mating systems were also highly informative and well synthesized. Chapter 14 on parenting tactics should be read by all of us struggling with "the most difficult of jobs" and especially by social workers and lawyers. I also think Alcock's final chapter on human behavior essential to those outside biology who still view human evolution as "discontinuous" from that of other primate species.

My favorite portions of the text, however, are the extra added attractions. The schematics and artwork are excellent. The diagrams, tables and figures are simple and clear and not overwhelming. The photography is equally outstanding, especially the colorful

"centerfold" photos with captions. My 11 year old daughter read all the captions after seeing the remarkable photos. The summary at the end of each chapter is very helpful to students of today, who frequently tell me they read the summary in the back of my anatomy/physiology text before they read the chapter. Alcock's list of suggested readings and discussion questions, also at the end of each chapter, are equally provocative. I also think his presentation of "the sociobiology controversy" (in chapter 16) to be relevant to today's students. I don't think I've read a better four page summary in any textbook. His glossary is complete and helpful but those references, all 1,334 of them, make this the best book on the shelf for those grad students undertaking a thesis in any aspect of animal behavior. What a superb compilation (with the single possible exception that M.T. Ghiselin's *The Economy of Nature and the Evolution of Sex* is omitted from the list of references, as previously mentioned).

Only a few minor quibbles - the conversational, almost tutorial tone of the writing was somewhat irksome to this reviewer but may be perfectly suited for most undergraduate and many graduate students. When explaining Niko Tinbergen's beewolf experiment, Alcock writes, "it worked like a charm" (p. 9). My wife's comment, "See, even scientists think magic is OK!" When discussing "The Development of Human Speech" (in chapter 2), the author often uses the word "speech" when he means "language" and vice versa. Also, in this reviewer's opinion, Alcock could have presented a little more of the known physiology when giving many of his behavioral examples, e.g. bird song. Perhaps this specificity would have been beyond the scope of this book.

Animal Behavior is an excellent text. It should be on every biologist's shelf. To my knowledge, it is the best text for an upper level or graduate course on "Animal Behavior". In addition, as a professor who taught "The Evolution of Human Communication" for 25 years, I found Alcock's 6th edition to be the precise book as a pre-requisite to those concerned with human linguistic origins. The last book I read was Charles Frazier's *Cold Mountain*. I couldn't imagine what I would possibly enjoy after reading Frazier's masterpiece. Alcock's *Animal Behavior* hit the spot.

HAL J. DANIEL III, *Department of Biology, East Carolina University, Greenville, NC 27834.*

Markham, Doug 1997. *Boxes, Rockets, and Pens. A History of Wildlife Recovery in Tennessee.* The University of Tennessee Press, Knoxville. \$19.96, 144 P.

This is a fascinating book on the history of wildlife management in Tennessee. It provides a detailed history of the efforts to restore several of Tennessee's wild animals -- both game and non-game species -- from near extinction. The first eight chapters discuss black bears, white-tailed deer, bald eagles, wild turkeys, river otters, Canada geese, red-cockaded woodpeckers, and red wolves. The final chapter looks at some lesser-known non-game animals such as bats and snakes, as well as Tennessee's efforts to manage watchable wildlife such as song birds, shore birds, birds of prey, turtles, toads, and frogs.

Although the title at first seems strange, the author notes that in most chapters either a box, a rocket, or a pen were important tools in restoration efforts.

The nontechnical writing style is interesting and captivating to the scientist as well as to the layman. The book contains a wealth of information concerning numbers and sources of introduced animals, dates of release and names of personnel involved. I have worked on mammals in and around the Great Smoky Mountains National Park since 1964. I have spent considerable time gathering data on recovery and reintroductions into the Park and can verify the accuracy of Markham's information. Even with my background and experience in eastern Tennessee it was an educational experience to read about these efforts on a Statewide basis.

Boxes, Rockets, and Pens is amply illustrated with 60 black-and-white photographs and a 16-page signature of 24 color photographs. An appendix of 8 pages lists the species that are endangered, threatened, or in need of management in Tennessee. Included in this section are mollusks, fishes, amphibians, reptiles, birds, mammals, and one crustacean, the Nashville crayfish. A 7-page section entitled "Notes" follows the Appendix. This section contains the sources of information used in the text, as well as technical data such as the number of harvested bears each year from 1951 through 1996, the number of eagles fledged each year in Tennessee, etc. Superscript notations throughout the text refer the interested reader to the Notes section which is organized by chapters and is easily accessed. A Bibliography containing 21 references is found at the end of the book.

Careful proofreading would have eliminated grammatical errors, wrong words, and omitted words on pages 6, 13, 28, 33, 36, 38, 47, 53, 55, 58, and 82. The annual event held in January in Pigeon Forge (at which I have presented programs for the past 3 years) is known as Wilderness Wildlife Week, not Wildlife Wilderness Week as stated on page 5.

Since the author has worked as an information and education coordinator with the Tennessee Wildlife Resources Agency since 1987, he has been able to draw from his own firsthand observations of recent wildlife history and from interviews with wildlife professionals. This book is a delight to read and should be in the library of anyone with an interest in Tennessee's wildlife, whether it be non-game or game species.

DONALD W. LINZEY, *Department of Biology, Wytheville Community College, Wytheville, Virginia 24382.*

Meffe, G.K., C.R. Carroll, and Contributors. 1997. **Principles of Conservation Biology**. Second Edition. Sinauer Associates, Inc., Sunderland, MA. \$54.95 hardcover. 729 pp.

The first edition of this important book on conservation biology (1994) won high praise from reviewers. The second edition is even more refined with contributions from a greater number of experts in more aspects of the discipline. And it has been expanded by some 129 pages and an additional chapter on conservation biology in the policy process. The basic format remains the same as in the first edition: chapters written by some dozen authors and essays and case histories from others on a wide variety of topics related to

conservation biology. Several case studies and some 24 essays are new, as is a greater focus on marine systems. The fact that a substantial revision of a well-received book could be accomplished in three years demonstrates just how rapidly the field of conservation biology is expanding and maturing.

The concept of ecosystem management has been incorporated and evaluated because of its widespread use, or at least its mandate, by federal and state agencies. "Ecosystem management" is ringing in the ears of land managers and supervisors, but few of them seem to know what it is all about. The new additions to this book explain the concept, provide background, and explore the complexity of managing lands and biodiversity from such a perspective. Readers will come away with a clear understanding of the issues and the need to look at conservation and management of species, communities, and ecosystems from a variety of integrated scales.

The thing I like most about this book is that, in addition to providing a solid, scientific background on theory and ecological concepts related to conservation biology, the authors contribute a wealth of information on "how to do" conservation biology in the real world. Nearly half the book deals with practical applications: management, restoration, economics, politics, policy, and sustainable development. Case studies and essays reveal the complexities and difficulties of meeting conservation goals, and one can be easily overwhelmed by it all. Meffe and Carroll sum it up by stating emphatically that the best hope for the conservation of biological diversity is updated and ecologically appropriate human value systems. This book illustrates ways that very goal is being achieved around the world by many people. The trick, it seems to me, is that each of us must change the value systems of our neighbors and politicians, and that is indeed a daunting task. Then and only then will the other four major actions needed (control human population growth, protect biodiversity centers, develop a global perspective, develop steady-state economics) have a snowball's chance of being achieved.

Structurally, this book is very well edited, perhaps enhanced by reviews of the first edition. The glossary with the annotation of which chapter focuses on a particular term is a useful touch. My brief scan of the literature cited (now in a 3 column format) revealed no typographical or bibliographical errors. The index (also in 3 columns) is very useful with topics, places, and scientific and common names of all species mentioned.

This publication is, I believe, specifically designed as a textbook. It would be best received by upper level undergraduates and graduates with some knowledge of ecological principles. First and second year undergraduates, non-majors, and adult students taking conservation-oriented biology courses in continuing education programs would be overwhelmed. Professors of these courses, however, should use it as their primary source of information and inspiration. Others who practice conservation biology and who are deeply involved in the discipline would also learn much from reading this book.

If you did not pick up a copy when it first appeared, then do so now. It is simply the best book available on the many aspects of conservation biology and ramifications of biodiversity loss. Every municipal and academic library should have two copies. Copies

should be made available to all practicing land managers and policymakers, and they should all be made to read it.

JOSEPH C. MITCHELL, *Department of Biology, University of Richmond, Richmond, VA 23173.*

Nicholson, Charles P. 1997. **Atlas of the Breeding Birds of Tennessee.**

University of Tennessee Press, Knoxville. \$45.00 hardbound. 426 pp.

Tennessee was the first state in the Southeast to have an organization devoted to the study of birds, the Tennessee Ornithological Society founded in 1915, and now it is one of the first states in the region to have a published atlas of its breeding birds. This carefully prepared atlas, based on six years of field work by hundreds of volunteers, is a mine of information about the biology of southeastern birds.

"Atlasing" began in Great Britain 30 years ago and quickly spread to North America and the rest of Europe. The objective is to determine the exact distribution of each species of bird within a geographic area. The basic method is to divide the area under study into a grid of quadrats, and then to recruit enough volunteers to determine the nesting status of each species in each quadrat. In Great Britain, with its high density of amateur birders, a breeding bird atlas can have quadrats 1 km² and can cover nearly every one. In an area the size of Tennessee, concessions to practically require that quadrats be much larger (in this case the area of a USGS 7.5-minute topographic map, some 5.1 by 4.6 km) and then that only a sampling of quadrats be surveyed. The project is still enormous. Although atlasing of this sort has usually received partial support from state wildlife agencies, the magnitude of the task necessitates the coordination of hundreds of volunteers. It is one of the most successful and conspicuous forms of "citizen science."

By now, at least five Canadian provinces and over a dozen states published breeding bird atlases. By all standards, the Tennessee atlas is one of the best. The introductory sections include clear discussions of the history of ornithology in Tennessee, the environment and landscape of the state, historic changes in the avifauna, and an overall analysis of the results. The latter includes a description of bird communities in the state based on a cluster analysis of the presence or absence of each species. Most of the book consists of the accounts of the species. For each an admirably clear map presents its status in each quadrat surveyed; often a second map, generated by interpolation of information from the surveyed quadrats, displays contours of abundance throughout the state. The text provides not only a detailed analysis of the results of the census, but also a clear and up-to-date review of the species' breeding biology. If nothing else, breeding bird atlases have helped to collate the scattered literature on the biology of nesting birds -- in addition to the new information acquired during the surveys.

As demonstrated by the published breeding bird atlases, birds continue to lead the rest of the biosphere as subjects of scientific study and conservation effort. The relative ease

with which birds can be observed and the large number of people now capable of identifying them accurately has assured their unique position as indicators of environmental health. Great Britain has already demonstrated that one of the most significant results of a breeding bird atlas comes in the future -- when the entire project is repeated 20 years later. For those of us committed to maintaining the biological diversity of our environment the, repetition of a carefully conceived breeding bird atlas will highlight where we have succeeded and where we have failed. In the meantime, everyone interested in the birds or habitats of Tennessee has many happy hours ahead learning about unsuspected intricacies of this state. The book provides an excellent reference for the biology of breeding birds that occur throughout the Southeast.

R. HAVEN WILEY, *Department of Biology, University of North Carolina, Chapel Hill, NC 27599-3280*

NEWS OF BIOLOGY IN THE SOUTHEAST

· Jon R. Fortman-News Editor
Division of Science and Math
Mississippi University for Women
Columbus, MS 39701

ABOUT PEOPLE AND PLACES

ALABAMA

Jacksonville State University, Biology Department. Drs. George Cline, Gary Durrant, Safaa Al-Hamdani, Frank Romano, and David Whetstone received an extension of their NASA/EPSCoR Grant. The project addresses changes in land cover types in the middle Coosa River drainage over a 15 year period, and analysis of forest types using satellite imagery, and an analysis of erosional soil loss off selected watersheds. Dr. Tom Baucom, JSU Geography, also assists on the project.

KENTUCKY

Western Kentucky University, Department of Biology. Dr. Shivendra V. Sahi has joined the faculty as a Plant Molecular Biologist. Dr. Sahi was formerly at **Alabama State**. Funding has been provided for the establishment of a Small Public Water System Technical Assistance Center in the Ogden Science College at WKU. The U.S. Senate Appropriations Committee has funded the Center for \$500,000 for the first of a five year

program. The Center will provide technical, managerial, and financial assistance to small water utilities that provide drinking water to communities of less than 10,000 residents. The Department has established Centers for Biodiversity and Biotechnology Studies. The Biodiversity Center is organized around three extensive organism holdings including the Herbarium and Max Hedley collection of Kentucky plants, the Lancaster collection of vertebrate and insect specimens, and the collection of Kentucky fishes. The Biotechnology Center enhances the educational experience of students seeking degrees or training in recombinant genetics and biotechnology.

MISSISSIPPI

Delta State University, Department of Biological Science. The Department is pleased to announce that *Dr. Keith J. Hughes* has accepted a faculty position beginning Fall semester 1998. Dr. Hughes, a microbiologist, holds the Ph.D. from ***Louisiana State University Medical Center in Shreveport***. Dr. Hughes comes to DSU from the ***LSU School of Veterinary Medicine*** where he held a postdoctoral appointment.

Mississippi University for Women, Division of Science and Math. Ms. Margaret Massey has left her position as Coordinator of Freshman Biology. *Dr. Marty Harvill* (Ph.D. ***Texas A&M, Zoology***) joined the Division this Fall. He comes from ***Bowling Green State University***. Dr. Harvill is an aquatic ecologist. *Dr. Bill Parker* has returned to full time teaching, after serving as Division Head.

NORTH CAROLINA

Appalachian State University, Department of Biology. Ms. Eileen Strahl received the Zigli award for the outstanding masters thesis in the University. Ms. Strahl's thesis adviser is *Dr. Bill Dobson*. *Dr. Doug Meikle*, chair of the department since 1995, has accepted the position of chair of the Zoology department at Miami University of Ohio. *Dr. Richard Henson* will serve as the interim chair. Dr. Henson also received one of the Board of Governors' Awards in Excellence in Teaching. *Dr. Judith Domer* has been appointed the Dean of Arts and Sciences. Her academic home is the Biology Department. *Dr. Floyd Domer* has been named as an adjunct professor in the department. The Domers have been at ***Tulane School of Medicine*** in New Orleans. *Dr. Mark Venable* received the William C. Stickland Award for the Outstanding Young Scholar for the university. *Dr. Zack Murell* joins the faculty as a plant systematist. Dr. Murell received his Ph.D. from ***Duke University*** and was on previously on the faculty of ***Western Kentucky University***,

East Carolina University, Department of Biology. *Dr. Ronald J. Newton*, Associate Head and Professor of the Department of Forest Science at ***Texas A & M University***, has been appointed Chair of the Department of Biology. *Dr. Donald Stanley* received a \$95,321 PCS Phosphate Research Grant for "PCS Phosphate Effluent Monitoring and Water Quality in the Pamlico River Estuary." *Dr. Mark Brinson* and *Karl Faser* received a grant for

"Tree Species distribution Along a North Carolina coastal Plain Stream Reach in Response to Hydrologic and Edaphic Gradients." *Martha Rheinhardt* received a grant for "Inventory and Quality Assessment of Nonriverine Wet Hardwood Forest Stands in the coastal Plain of North Carolina." Two \$10,000 awards from the University of Virginia went to *Drs. Robert Christian* and *Mark Brinson* for Contributions to Long-term Ecological Research at the Virginia Coast Reserve. Assistant Professor *Francis P. Belcik*, Invertebrate Zoologist and Parasitologist, has retired after 32 years of service.

Wake Forest University. *Dr. Mordecai J. Jaffe*, Babcock Professor of Botany from 1980 to 1998, retired from the University in May, 1998. Professor Jaffe has taken an emeritus position at Cornell University. *Dr. William K. Smith*, has joined the department as the Babcock Professor Botany. He came to Wake Forest from the University of Wyoming. *Dr. Smith* received the Ph.D. from the University of California at Los Angeles and is a plant physiological ecologist who has worked extensively on plant adaptations to harsh environments. *Dr. Miles R. Silman* has joined the department as an Assistant Professor. *Dr. Silman* received the Ph.D. from **Duke University** and is a plant population ecologist with research programs in Peru, Ecuador and Panama, as well as in Virginia. *Dr. Jennifer C. Waters*, Visiting Assistant Professor, received the Ph.D. from the **University of North Carolina at Chapel Hill**. *Dr. Waters* is a microscopy/image analysis specialist who is the Director of the Microscopy Facility in the Department. *Dr. A. Daniel Johnson*, Visiting Assistant Professor, received the Ph.D. from Wake Forest University, and joined the Department from the **University of Virginia**, as the Core Curriculum Coordinator. *Dr. Gerald W. Esch*, Wake Forest Professor of Biology, has received the Mentor Award from the American Society of Parasitologists, a distinguished award for which one is nominated by former students.

TENNESSEE

Union University, Department of Biology. *Dr. James Huggins* has been named Chair of the Department. *Dr. Wayne Woolford* has been named Director of the Center for Scientific Studies.

University of Tennessee, Knoxville, Department of Botany. *Dr. Massimo Pigliucci*, Assistant Professor of Ecology and Evolution, has been granted tenure and promoted to Associate Professor. *Dr. Pigliucci* is a "Dobzhansky" Awardee of the Society for the Study of Evolution. He and his postdoctoral associate, *Dr. Hilary Callahan*, have been awarded an NSF grant for two years to study the evolution of responses to light quality and photoperiod in *Arabidopsis*. *Dr. Callahan* will join the faculty at Barnard College in New York starting in the Summer of 1999. *Dr. Pigliucci* has been on a short sabbatical in France at the University of Paris-Sud where he also taught a mini-course on phenotypic plasticity. His book, co-authored with Carl Schlichting and titled, "Phenotypic Evolution: A Reaction Norm Perspective," has just been published by Sinauer.

MUSEUMS AND BOTANICAL GARDENS

ALABAMA

Anniston Museum of Natural History. The Museum announces the appointment of *R. Cecil Price, Jr.* to the position of Curator of Exhibits. Price will be responsible for supervising the exhibition department and planning new permanent and temporary exhibits. He is a native of New Orleans, Louisiana with a B.S. degree in Zoology from **Southeastern Louisiana University**. He worked for two years with the **Audubon Zoological Gardens**, and the past nine years as assistant curator in the husbandry department at the **Aquarium of the Americas**. The Anniston Museum Board is considering an arrangement whereby both the Anniston Museum of Natural History and the Berman Museum would be supervised by one director and museum board. They would also share staff. Although they maintain and exhibit vastly different collections, central management would prove economical and beneficial to future growth.

FLORIDA

Marie Selby Botanical Gardens, Sarasota. Approximately 250 scientists from more than 35 countries and as many states in the U.S. will convene at the Gardens, November 4-8 1998, for the Second International Canopy Conference, "Forest Canopies 98: Global Perspectives." Selby's director of research and conservation, *Dr. Margaret Lowman*, is recognized as a pioneer in the field of forest canopy exploration and will serve as co-chair of the conference with *Dr. Francis Halle* from the Institut de Botanique in France. ASB members who might wish to attend the conference may do so on a daily basis for \$100 (lunch included) or the entire conference (meals included) for \$275. Teachers with valid identification may attend a single day for \$75 (lunch included). Call 941-366-5731 ext. 10 for more information. On November 4, 1998, some 200 seventh through twelfth grade students from the Sarasota area will have the opportunity to meet with internationally renowned field biologists to learn about their research in canopy ecology. There will also be a special workshop for students and teachers of the Sarasota region to interact with the field biologists attending the conference. The program will be: (1) Insects from Tropical Rain Forest Canopies by *Dr. Nathan Erwin*, Director of the Smithsonian Insect Zoo; (2) Collecting Insects in the Forest Canopy by *H. Bruce Rinker*, Millbrook School, New York; (3) Tree-climbing and other Methods to Access the Treetops by Bart Bouricius, *Dr. Philip Wittman*, and *Robbie Oates* (Canopy Construction Associates); (4) Plant Collections and identification of epiphytes by *Bruce Holst*, Herbarium Manager, Selby Gardens; (5) Photography as a Scientific Tool by *Chris Knight*, photographer for the book, *The Most Beautiful Roof in the World* and former National Geographic photographer. Other programs are also scheduled during the workshop.

GEORGIA

The Columbus Museum, Columbus, GA. Photographs of the Bartram Trail by Brad Sanders will be on display until August 30, 1998. This selection of photographs traces the path of the early American naturalist William Bartram's important eighteenth-century travels across the region.

Erratum The photograph of the termite on the cover of the January issue of the *ASB Bulletin* was taken by Dr. Anthony Curtis, Ph.D., Biology Department, Virginia Western Community College, Roanoke, VA 24038 acurtis@vw.cc.va.us



Gibbs Award for Excellence in Systematic Ichthyology

Nominations are invited for the American Society of Ichthyologists and Herpetologists (ASIH) Robert H. Gibbs, Jr. Memorial Award for Excellence in Systematic Ichthyology.

Prizes are awarded for an outstanding body of published work in systematic ichthyology by a citizen of a Western Hemisphere nation who has not been a recipient of the award. The award is offered annually and consists of an appropriate plaque and a cash sum. The award recipient is announced at the Annual Meeting of the ASIH. The award for 1998, including a plaque and \$6000, was presented to C. Richard Robins, Los Angeles County Museum, Los Angeles, for his numerous contributions to the systematics of many diverse groups, including eels, cusk eels, ophidiids, gobies, blennioids, sculpins, suckers, and North American fishes in general.

Nominations may be made by any ichthyologist, including self nominations, and should include the nominee's curriculum vitae and detail the nominee's specific contributions and overall impact on systematic ichthyology. Nominations must be received by March 1 of the year to be eligible for the award for that year. Nominations will be effective for three award years. Four copies of each nomination should be sent to Dr. Robert K. Johnson, Grice Marine Biological Laboratory, 205 Fort Johnson Road, Charleston, SC 29412, USA.

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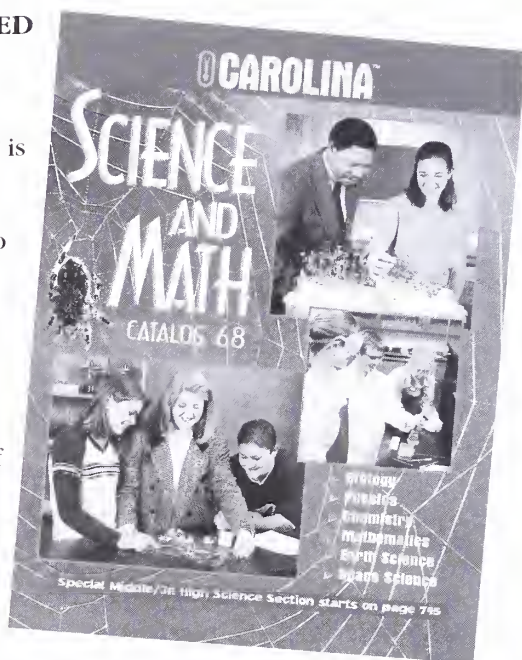
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THE *ASB BULLETIN*
Volume 45, Number 3, September 1998

IN THIS ISSUE

NEW PUBLICATION DATES, NEW FORMAT AND NEW LOGO	139
1998 MERITORIOUS TEACHER	140
1998 RESEARCH AWARD RECIPIENTS	141
TREASURER'S REPORT	144
ASB OFFICERS, COMMITTEES AND REPRESENTATIVES AND <i>ASB BULLETIN</i> STAFF ..	147
1999 MEETING OF THE ASSOCIATION	151
Call for Papers	151
Guidelines for Poster Session and ASB Poster Award (\$300)	154
Nomination for ASB Officers and Executive Committee Positions	155
"Travel" Support Awards for Graduate Student Members of ASB	156
Meritorious Teaching Award Nomination	157
Research Awards	158
OBITUARY: DR. WALTER SAMUEL FLORY, JR.	161
NEW COMMITTEE	163
BETA BETA BETA PAPERS AND POSTERS	165
REVIEWS	175
NEWS OF BIOLOGY IN THE SOUTHEAST	180

Cover photo by Robert Parriott, Appalachian State University, Boone, NC 28608

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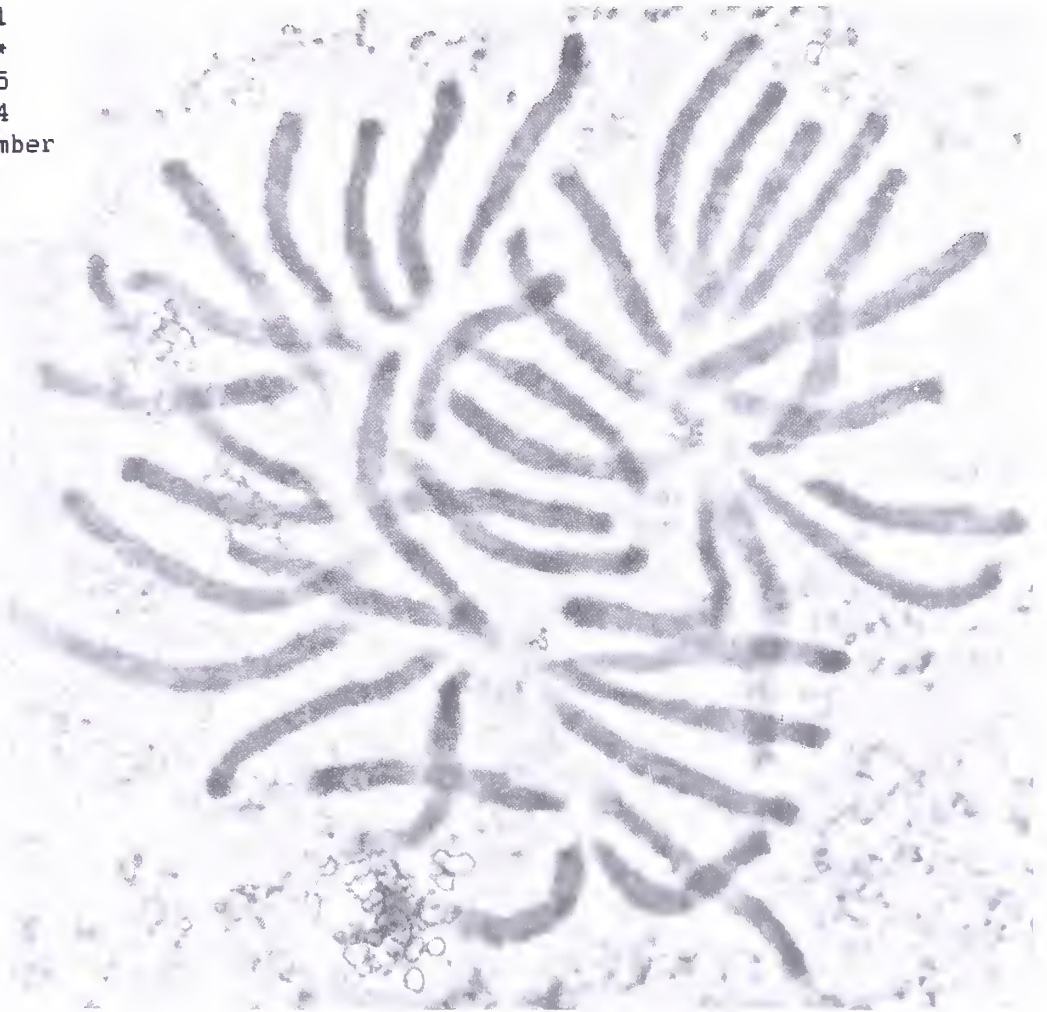
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Issues In Biology

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Mitosis in a spider embryo

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PURPOSE

The purpose of this association shall be to promote the advancement of biology as a science by encouraging research the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. Members receive the *ASB Bulletin*.

TIME AND PLACE OF FUTURE MEETINGS

1999	April 14-17	University of North Carolina at Wilmington, Wilmington, NC
2000	April 5-8	University of Tennessee at Chattanooga, Chattanooga, TN

ISSUES IN BIOLOGY

In this issue the *ASB Bulletin* begins a new feature that aims to address various topics in biology that are of interest to biologists in general and those in the Southeast in particular. The first of these topics is the question of collections of organisms for research and teaching. What is the use of small collections? Should they be amassed in small and large institutions? If they should be kept only in larger institutions, who should bear the cost of collecting and maintaining such collections and who should determine the ultimate fate of them?

Wayne Van Devender opens the discussion with a consideration of his vertebrate collection at a comprehensive university. His article actually represents the problems of many types of animal collections. He invites response to his thought-provoking ideas from individuals at both larger and smaller institutions. Appropriate responses will be published in a future issue.

Robert Haynes and Zack Murrell express differing viewpoints on the question of where plant collections should be housed and how the problems attendant with them should be addressed. In this discussion each has written a position paper, they have swapped the papers and have written responses to the other's paper. It is hoped that this format can be followed in future discussions of controversial topics.

Finally, an article by Dr. Ritchie Bell is being reprinted. Dr. Bell's article first appeared in 1959, but the issues he raises have a very modern ring to them.

Please note that this issue of the *ASB Bulletin* has no Association news or business. The fourth issue of the year will, from this point, be devoted to Issues in Biology, original research papers, book reviews, and on a space available basis, announcements of symposia, summer institutes, position available announcements etc. If there is a topic that you would like to see addressed in a future issue, please contact the editor or any member of the Publications Committee. We are already working on the fourth issue of the 46th volume and have some good people addressing a most interesting topic. We would be interested in suggestions of good scientists who could approach the topics you suggest from different viewpoints.

VERTEBRATE COLLECTIONS AT SMALLER SCHOOLS - GOOD OR BAD PART 1

DR. WAYNE VAN DEVENDER

DEPARTMENT OF BIOLOGY, APPALACHIAN STATE UNIVERSITY

A while back Ken Shull asked me to share with all of you some of my thoughts about maintaining specimen collections at "smaller schools." Ken knew that this subject is one that elicits a fairly vigorous response from me and wanted to get me to start a forum where folks from different disciplines can comment on this important and timely set of issues.

I feel a bit like someone at an AA meeting. Before anyone is likely to pay much attention to my comments it is necessary to give you some background information about me and what I have done here at Appalachian State University in the last 20 years. Right up front - I confess! I am guilty! I do maintain a collection here and am proud of it! I am also guilty of most of the character flaws that make someone want/need to have a collection. I am: A. An idiot, B. A herpetologist, C. A somewhat classically trained vertebrate zoologist, D. A field biologist., E. A population biologist, F. A cheapskate, G. A little obsessive, H. An evolutionary biologist, I. An interested observer of mammals, J. A pragmatist who wants to see the structures I read about in the books, K. A teacher who thinks students should share in all these interests, L. All of the above - already. *Mea culpa* on all counts.

When I arrived at Appalachian in 1978, I was expected to teach field-oriented courses on herpetology and mammalogy. That sounded like fun until I saw the materials I had available for the two courses. There were a few store-bought mammal skulls and a couple of hundred herp specimens accumulated by one of the graduate students. How could I show the students about the range of diversity these creatures exhibit - even in their own home state? I asked several museums about borrowing complete, synoptic sets (representatives of all species) and was told how difficult that would be and that the students would not really be able to handle (use) the specimens that could be loaned. I was even admonished that I should refrain from building a collection at Appalachian because it would simply make work for the museums later on when I got tired of the specimens and either gave up the collection, retired, or died. To make matters worse, I had almost no funds to procure the specimens I wanted for teaching or research projects. What a situation. How could all these problems be solved?

One answer, of course, was to temporize at first and start building the collection that I wanted/needed. Since my courses were field-oriented, I asked the students to make collections and used those as the nucleus of the ASU collection of the future. I also called in any outstanding debts around the country and asked for teaching material. I also began exchanging with as many places as I could find. I started a dermestid colony for cleaning skulls. I started a collection of color slides of creatures and their parts that could fill in the gaps in the local collection. I wheedled some money to buy jars and alcohol. I started drinking Nescafe instant coffee because

their jars were just right for my needs. I made field trips to collect important material, *etc.* Year by year, the collection improved. Year by year, the teaching and research possibilities improved.

Today, the ASU collection of mammals, amphibians, and reptiles includes about 22,000 catalogued specimens and a few thousand more that are awaiting cataloguing. The collection grew rapidly at first and less so lately. In recent years, many specimens have been passed on to other, newer collections building around the state and country. The time has come to repay debts to the community that helped me out in the beginning. The slide collection has also grown to over 70,000, but its rate of growth has not slowed. The time required to maintain the collection has grown from a few minutes a day to become my primary (and secondary) hobbies.

Somewhere around 15,000 specimens my collection took on a life of its own and seemed to require a full-time curator to keep it from falling apart. What used to be an occasional glance at the bottles to see who needed filling or what needed cataloguing, now became a desperate effort to not lose or ruin things. Specimen preparation became one of those things that took too much time and energy. Use of a **good** (emphasis necessary) work study student or two allowed some continued growth, but the era of active expansion was over. Growth was also hindered because the space available for the collection was completely saturated. There was little room for new and different things, especially larger ones. Nevertheless, there have been only occasional periods when I have felt like sending the whole thing off to the Smithsonian (or University of Michigan, or The Carnegie Museum, or North Carolina Museum of Natural History). The services provided by the collection still make it more valuable to me to keep than to lose. Since these services probably are not completely evident to other sorts of biologists, justification of the collection maintenance will require a brief discussion of why we need specimens, what we use them for, and what happens to them when we have already used them once.

I am routinely castigated by students and (a bit more tolerantly) by my colleagues for killing every animal I come across. While I have done in a lot of animals in my time, I try to operate with the understanding that there **MUST** be some reason to remove an animal from its habitat. The animal should then be used for the purpose it was collected. Since it is usually not feasible to return the animals to their habitats, I try to make the maximal use possible of every specimen. I photograph them, find out if they are needed in other people's research, remove tissue from them, and finally add them to the collection here. I firmly believe that everything in science should have voucher specimens and I keep them. If you want to check up on my work or that of my students, come on in and look at our specimens. Preserved specimens document the species used for a particular study and are available for further studies and/or use in teaching.

I am afraid I do have a number of different uses for specimens and I do use a lot of them in any given year. The value of a particular specimen depends on several factors. I value highly the first individuals of any species that comes to me for study. That first animal will certainly be photographed, catalogued, and used in as many ways as possible. The second individual of that species provides a little more information about variation in the taxon and is valued almost as much as the first.

Members of additional series of individuals of the species provide skeletal preparations, tissue samples, subjects for laboratory studies, exemplars for various photo exhibitions, trading material, *etc.* All specimens provide archival information about where that species occurred at one particular point in time. Series of animals from that site provide so much more information on size/age groups, size at maturity, fecundity, frequency of tail loss, *etc.* Some population ecology studies require the slow accumulation of specimens that are never encountered frequently. The specimens I get are used extensively before they are preserved. After they are preserved, they can continue serving the needs of the scientific community and ASU student for many years. For many applications we can simply go to the collection and examine specimens already here, so no additional animals are needed or collected. This approach seems far better than burying the dead every year and repeating the slaughter every time we want to look at a particular aspect of some species. EVERY specimen (even salamanders!) represents an animal removed from its home and warrants the same respect that we all are inclined to give pandas, whales, and lions. We can never imagine all the possible questions that could be asked, so we must keep our dead specimens for further reference.

Every year I discover new and different reasons to value collections of preserved animals, but not everyone will want to put up with the accessory "costs" of maintaining their own collection. Depending on the size of the collection, these costs can be relatively minor or overwhelming. A minimum investment in a herpetological collection would include jars, lids, formaldehyde, alcohol, waterproof specimen tags or labels, jar labels, catalogues, and the space to store the whole thing. For a few dozen salamanders, this expense is completely negligible; but adding a collection of creatures from Thailand to the same collection would require a much greater investment in jars, alcohol, space, and time. Large mammal skulls or turtles also pose expensive problems. During periods of active growth any collection will require a lot of time, space, and money. At least some of the money and space should be provided by the home institution since the collection offsets the expense of purchasing materials for the relevant courses. So long as these costs are small, everyone seems to benefit by keeping the specimens around. However, an interesting set of problems arise as the collection grows larger each year.

Larger collections require greater investments in time, space, and all sorts of resources. At some point, the costs of keeping the collection begin to exceed the costs of purchasing specimens for teaching. In addition, most of us are going to be unsuccessful in convincing our chairpersons that the demands of the collection are such that we really need to stop teaching and doing research and become collection managers or curators. How can we recognize this critical point in the history of a collection and what steps should be taken? These are tough questions with different questions for different people and different situations. Some of the answers are straightforward:

1. Stop adding to the collection except to replace losses.
2. Donate part or all of the collection to larger, regional collections.
3. Discard the collection entirely and re-assign the poor addled professor.
4. Continue the spiral of escalation until some breaking point is reached.

5. Donate parts of the collection to other teaching institutions.
6. Redirect the collection growth along smaller, cheaper avenues.
7. Increase the utilization of the collection to maintain a favorable cost/benefit ratio.
8. Arrange some resource sharing with other institutions.
9. Reduce collection size by exchanging some of current holdings for new material.
20. *Etc.*

The solution for any collection will depend on the time, interest, energy, and commitment of the particular faculty member and his/her particular political environment, but a number of scenarios come to mind that lead to specific problems with collections. What happens to the collection when the focal person finally retires or dies? What happens when the department rededicates itself completely to molecular biology? What is the best way to “dispose” of a collection when it is deemed to be surplus? Who really owns the collection and who is legally responsible for it?

This article is meant to start discussion about collections, their value, and their use. I hope that I touched on some issues that will generate some discussion. There are many more issues that will have to wait for another deadline. To get the discussion going, I have asked several other herpetologists and mammalogists from different sectors to review my commentary and contribute their thoughts to the discussion. I anticipate some differences of opinion on some issues, so here should be some things to look forward to in upcoming *ASB Bulletins*.

ORPHANED HERBARIA SHOULD BE UNITED WITH LARGER HERBARIA

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Herbaria are extremely valuable for the training of graduate and undergraduate students in floristic botany. Every department that trains such students needs access to a good, well operating herbarium. Over the past 100 years, active botanists have initiated many herbaria as they moved to colleges or universities without such facilities. In many cases, these botanists developed good collections of the local flora. Slowly, the above-mentioned botanists retire. What should happen to the collections that have been amassed in these herbaria? Should they remain at the college or university where they were developed, or should they be moved to larger, potentially more active herbaria? I think that almost all botanists interested in training graduate and undergraduate students would certainly say that the herbarium should stay at the institution in which it was begun if another botanist with similar interests replaced the retiring person. Unfortunately, many, many colleges and universities are not replacing taxonomic botanists as they retire. Why is this happening? I have my opinions, which may or may not be correct. Regardless, it is happening. In many

situations, the doors of the herbarium cabinets are closed, and never opened again. Eventually, some faculty member questions why the valuable space is being "wasted" by those cabinets, and they finally are just discarded.

There is a big push among botanists in North America to produce a Flora of North America (FNA). Three volumes of a projected 32 volumes are already in print, and a fourth volume has already gone to the printer. As part of the research in preparing a treatment for FNA, one needs to determine the overall range in North America of a species. One cannot adequately determine this range without looking at thousands or even tens of thousands of specimens. As one who authored or co-authored 11 families for the forth-coming volume four, I personally examined in excess of 30,000 specimens of those 11 families, as did my co-author. For those 11 families, then, we examined in excess of 60,000 specimens, specimens that not only were housed at the major institutions, for example, New York Botanical Garden, Missouri Botanical Garden, *etc.*, but also major state collections and small local herbaria. What one finds is that in many instances, it is these small local collections that extend the range within a state or province. Certainly, in many, if not most instances, this range extension is only a county or two, and of little significance for FNA. Occasionally, however, this extension is quite significant, sometimes being the only report of a species for a state or province. If the herbarium is lost, so are the data associated with the specimen and the proof that the species ever existed in the area. One who has very little understanding of the importance of knowing the range of a species may ask why should we worry that the only voucher of a species for a state, county, *etc.* has been lost. As our environment continues to be impacted, species are being lost in an area, and even going extinct, at an increasing and alarming rate. Voucher specimens are the only evidence of what actually occurred in an area. A list of species present says one thing, but it does not mean nearly what a collection of vouchers means.

As companies propose to develop certain areas, they must have approval from either the Army Corps of Engineers or the Fish and Wildlife Service, often both, especially if the development will impact a wetland or an area where federally listed threatened or endangered species exist. What makes a jurisdictional wetland? There are long detailed regulatory procedures, but the long and short of it is that a wetland supports wetland plants. If wetland species are present, it is a wetland. How do we know they are present? Certainly a survey will determine that, but these then need to be vouchered. These vouchers are often placed in a local herbarium. We are again back to the value of making sure these small herbaria (at least the specimens in these small herbaria) are maintained. I firmly believe that every effort should be made to convince the administration of every college or university of the importance of training persons how to recognize species and how to maintain herbarium collections. When the administrators cannot be convinced of this important situation, then every effort should be made to move the herbarium housed at that institution to a larger institution, one that has shown evidence of its commitment to maintain and improve scientific collections.

When I was in graduate school, I was told many times that a voucher specimen should be deposited in the herbarium for all research projects undertaken. For

example, anytime chromosome numbers were counted for a plant, that particular plant should be made a voucher. The same also applied to chemical or morphological studies. My professors always told me that if a properly prepared voucher specimen is available in a herbarium, then no one must depend on your identification of the specimen on which the research was undertaken. Anyone that questions the data can always examine the specimen and decide for himself/herself. I contend the same applies to research in all areas of botany, be it physiology, anatomy, ecology, *etc.* A former colleague of mine, now deceased, told me that while he was on the staff of a major research herbarium (one not directly associated with a university), that a person doing physiological research on *Elodea* came into the herbarium one day and asked the scientific name for *Elodea*. It seems that person had submitted some research for publication, and a reviewer had asked to what species of *Elodea* the research applied. The manuscript listed the taxon to the generic level only. That person did not know, so he/she went to the nearest herbarium to find out. My friend asked which *Elodea* the person was concerned about. The researcher, to my friend's surprise, commented that he/she was unaware there were more than one species of the genus. Consequently, the only recourse was to take the person into the collection to examine sheets of the genus, after which a name was chosen. Knowing what I do about the Hydrocharitaceae, I strongly doubt the species in question was even a member of the genus *Elodea*, since the material for the research was obtained from "a local aquarium supply store." *Egeria*, not *Elodea* is usually sold as elodea at aquarium stores. The value of that research, regardless of whether it was ever published or not, is limited at best, because we do not know for certain to what genus, much less species, the research applies. The person should have supplied a sample of the material to a taxonomist at the herbarium, who would have determined it and then would have made a specimen for a voucher. Vouchers of every research project on plants should be deposited in a herbarium and every effort should be made to insure that those vouchers are maintained safely and permanently.

One can go on and on giving examples of how local herbaria are important and giving reasons why they should be maintained throughout the country, but if we cannot convince the administration at an institution of their importance, then we must do everything possible to get the collection moved. With the current attitudes of faculty of biological sciences departments throughout the country, the situation described above will get much worse long before it gets better.

WHAT IS THE FUNCTION OF A HERBARIUM IN A DEPARTMENT OF BIOLOGY AT COLLEGES AND COMPREHENSIVE UNIVERSITIES?

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Recent studies have shown that smaller herbaria throughout the Southeast, and even some larger herbaria, are being orphaned by their supporting institutions. When we look at individual institutions we see that these decisions are sometimes based on changes in personnel, and at other times are based on departmental or institution-wide changes in direction. In the following discussion, I will address some of the issues involved in these decisions, to demonstrate the value of herbaria at colleges and comprehensive universities in the Southeast.

Over the past two decades we have witnessed several developing trends in the field of systematics. Many have been very positive, such as the development of phylogenetic (cladistic) and phenetic (numerical taxonomic) methodologies, the development of DNA sequencing methods, and the development of Polymerase Chain Reaction (PCR) based methods such as Randomly Amplified Polymorphic DNA (RAPDs), Amplified Fragment Length Polymorphisms (AFLPs), and Inter-Simple Sequence Repeats (ISSRs). These developments have led to a resurgence of systematic research in botany, zoology, mycology, and microbiology. However, coupled with these positive developments has been a gradual loss of emphasis on organismic biology and morphological systematics in Departments of Biology throughout the country.

Many reasons have been put forth for the lack of interest or support for morphological systematics. Many believe that the molecular data available today are qualitatively better than morphological data. The reliance on molecular data for phylogenetic reconstructions in most of the studies presented at recent national meetings would support this belief. Others consider the funding agencies to be at fault for funding directed toward molecular studies to the exclusion of morphological studies. If we are to blame the funding agencies, we must also fault the universities and the faculty within that judge the quality of researchers only on the basis of the amount of overhead generated, and not on the quality of the research. Some would blame the morphological systematists for not doing a good job of advocating their own field of study. Regardless of where we direct our blame for the apparent losses in the field of morphological systematics, these changes in systematics and Departments of Biology are putting significant pressure on herbarium curators to justify the existence of herbaria.

Many colleges and universities have decided they could not afford the costs (in both space and support personnel) of herbaria and have chosen to divest themselves of this perceived "burden." I believe there are two fundamental questions these institutions must ask in making these decisions. First, is the perception of organismal biology and morphological systematics as being "old-fashioned" a

realistic perception, or does it represent a certain level of ignorance of changes in this field of study? Second, what is the cost in student learning, from moving in these "modern" directions and leaving behind the "old-fashioned" sciences? I will address these questions, in turn, and then confront the bigger issue of the effect these changes will have on science and learning.

The field of systematics has undergone a revolution over the past three decades. I believe the effect of these changes has been the development of a rigorous methodology that has finally "caught up" with our understanding of evolution. We see these methods being used throughout biology, as can be ascertained by perusing the major biological journals. Interestingly, advances in image capture and investigations of shape and size, investigations of the molecular basis of morphological change using *Arabidopsis* as a model system, and micromorphological advances with new methods of microscopy have provided us with tremendous tools to begin testing various concepts of adaptation and evolutionary change. These advances have been coupled with some excellent studies by Peter Stevens and others on how we recognize characters and character states, work on hybrids by Lucinda McDade, Loren Rieseberg and others where we are beginning to see how characters change from parent to offspring in various studies of hybridization, and studies by Walter Judd and others that are beginning to develop sound morphological phylogenies we can use in the classroom. Based upon these advances it is clear that there is a vigorous "modern" field of morphological systematics, suggesting that the perception of morphological systematics as "old-fashioned" is one of ignorance and not realism.

With the tremendous growth of science over the past few decades, we have seen an accompanying rise in the amount of data or facts that we ask students to master. In spite of this situation, what framework do we give students to assemble these facts, and where do they get the background needed to formulate questions and develop hypotheses? Modern systematics offers a methodology to test various hypotheses of evolutionary relationships. Organismic biology and modern systematics offers students the framework of evolution to assemble their ideas and questions about life. This framework in organismic biology, systematics, and evolution provides a foundation for future exploration of physiology, ecology, and molecular biology. As departments move away from an organismic approach to learning, are we providing students with a better education, or simply an education based on facts, with no foundation in the real world?

I believe organismic studies are at the crux of the issue of science and learning in the future. In our attempt to deal with the flood of data from the scientific community, and in our confusion between good science and high-priced science, we are creating a situation where the biologists of tomorrow will have no idea how their own research fits in the larger context of understanding life and the complexities of evolution. I believe that organismic studies are critical for the growth and learning of young biologists, and should be incorporated into every biology major's study. By examining the diversity of life and the easily observable character state changes in various plant groups, students can then use this information as a basis for asking questions within the realms of physiology, molecular biology, and ecology.

Herbaria, coupled with zoological museums, greenhouses and field studies, should be the cornerstone of every biology department's training in organismic biology. Herbaria offer a way for students to travel the world, examine phenotypic plasticity within and between taxa, and get a good idea of the biogeographical and ecological variation within and between various groups of plants. Without a foundation in organismic biology, I fear we are generating students with excellent technical skills, but with no understanding of how these data can be used creatively in the study of botany or biology.

A look at the future of morphological studies provides a cogent rationale for colleges and universities to support this type of research. In recent research with mutant *Arabidopsis* we are beginning to find the genetic basis of various characters. This research will have tremendous value to society, as we develop the use of this technology to "create" new organisms by inserting genes from other organisms. As we develop our understanding of the genetic basis of various character states, we will be able to then take this genetic information and use it in the production of transgenic organisms. We will only know what is the best gene to insert if we know the distribution of character states in the plant kingdom. The need to know the distribution of characters and character states will be fundamental to this type of research, yet without morphological systematics, this information will not be easily available, since it is so costly and painstaking to locate these genes using molecular search strategies. If, through studies in morphological systematics, we can understand the distribution of different characters in various groups and the evolutionary direction of character state changes in these groups, we can then use this information to explore the world of plants for the best genes for our transgenic constructions. Without this information, we will miss an opportunity to maximize the potential of this exciting field of molecular biology.

A second need to support morphological studies can be seen in our growing need to reconstruct natural communities. As we manipulate our environment, we are seeing a future where we must be able to reconstruct natural communities that have been destroyed, and our understanding of plant characteristics and plant relationships is fundamental to this effort. Morphological systematics can and must provide this needed information if we are to cope with the anthropogenic changes to our biosphere.

A third reason to support morphological systematics is a result of the extreme disparity in funding for morphological versus molecular studies. This disparity has created a situation where molecular systematists have no comparable modern morphological analyses to adequately evaluate the strengths and weaknesses of their hypothesized phylogenies. Many systematists pretend to make adequate comparisons using studies from the last century, but these "straw men" are often so rife with problems that they become useless for comparative purposes. If molecular systematists truly want to test the validity of molecular analyses and gene trees, this lack of rigorous morphological analyses should provide a strong incentive to support morphological systematic studies. It is clear that we can continue molecular studies in the absence of organismal studies; the question that we must ask is, what will be

the value of that molecular information if it is not coupled with advances in organismic studies?

Small herbaria also have intrinsic value outside of morphological systematics. They are a major source of information concerning the biota of the various regions of the country. Although much of the data concerning plants that are considered imperiled has been gathered by various conservation groups, we cannot really document rarity without knowing what is not rare. As we debate rates of climatic change and the potential effects of climatic change on vegetation, we can obtain valuable baseline data to determine the flora of the recent past by developing an inventory of these smaller herbaria. Small herbaria also serve as a repository for vouchers from studies completed at the supporting institutions. Often we see studies that are not well documented, and all of us had have the experience of realizing the value of having good vouchers for our research. The importance of vouchers should make researchers at the various institutions deeply concerned that they can rely on a safe and easily accessible location to deposit these crucial specimens. Smaller herbaria are clearly a treasure chest of information, waiting to be examined with modern tools.

Some may argue that these intrinsic values may be valid, but these data could be easily mined after the small herbaria have been included within larger regional herbaria. Is there any reason to maintain these small herbaria as individual self-sustaining units? The most important and urgent reason to maintain herbaria at colleges and comprehensive universities is the fundamental value of herbaria as teaching tools. Organismic studies are a fundamental part of biology and evolution, and the need to teach organismic biology to all students of biology is just as important today as it was a century ago. The future of biology, as we develop means to generate new organisms and are forced to rebuild new communities, is dependent on the continued development of organismic biology. When we begin to examine possible sources for the scientists of the future, in order to have investigators available to confront these issues, we discover that the colleges and comprehensive universities are the places where students develop interests in biology, and then these students get advanced degrees and become productive members of the scientific community. Students of molecular biology, physiology and ecology can greatly benefit from an understanding of morphology and anatomy, and the use of these data to generate hypotheses of evolutionary relationships using modern methodologies. Students of systematic biology can greatly benefit from the resources available in the smaller collections throughout the region and the country. The scientific community should insist that student research is properly vouchered, and scientists should insist that they and their students have a safe and accessible location to store voucher specimens. Clearly these are strong reasons to support organismal studies and herbaria at colleges and comprehensive universities in this country.

What can we do to support herbaria at colleges and comprehensive universities? First, each of us should carefully enunciate the value of organismic biology within our own institutions. Second, we should communicate with funding sources within and outside of academia about the value of herbarium studies and the need to support

organismic and morphological research. Third, the conservation groups that have benefitted from the resources offered by the smaller herbaria should increase their own efforts to support organismic biology and the herbaria that helped build their extensive databases. Fourth, large herbaria should develop partnerships with the smaller regional herbaria, especially in efforts to computerize herbaria. Finally, the larger universities, museums, and botanical gardens should lend support to these smaller institutions by trying to educate the administrations of those institutions that are abandoning organismic studies before they offer to incorporate the orphaned collections within their own collections.

If we choose to ignore organismic biology at the college and comprehensive universities, we are creating a generation of scientists without the skills to deal with the problems we are beginning to see on the horizon. If we choose not to support the relatively small herbaria at these institutions, we are losing one of the major tools that can be used to generate excitement and questions about plant diversity and evolution. If larger universities, museums, and botanical gardens do not take a leadership role in supporting the efforts of colleges and comprehensive universities, then they will be faced with a shortage of students, researchers, and professors in the very near future. Finally, if we choose to give up, and ignore this short-sighted trend toward molecular and ecological studies, and away from species level organismic studies, we must be willing to take some responsibility for the damaging effect this will have on the biological sciences and on our ability to take advantage of the technological innovations available to the biologists of today and tomorrow.

**COMMENT ON POSITION TAKEN BY ZACK MURRELL
BY ROBERT HAYNES**

Dr. Murrell is absolutely correct with his comments on the function of a herbarium in a department of biology. As I stated in my paper, I believe without question that herbaria are essential for any department attempting to train biologists in any area of field botany.

My only concern is when we cannot convince the administration or faculty of a college or university where an "orphaned" herbarium exists of the value of that herbarium. What are we to do with it. I contend that the collection should not be mothballed there. The reason being that eventually someone will want to get rid of it. Often that does not happen until the specimens are useless because of neglect. Instead, I think that the specimens should be moved to a facility that has shown its desire to maintain and use biological specimens.

In short, if an institution is not willing to commit to keeping a scientist who has an interest in maintaining a scientific collection, then the collection should go to an institution with such a commitment.

**COMMENT ON POSITION TAKEN BY ROBERT HAYNES
BY ZACK MURRELL**

I agree with Dr. Haynes' appraisal of why we need herbaria; however, I disagree with his argument for moving the smaller herbaria to larger institutions if "we cannot convince the administration at an institution of their importance." Although this is may be a position of practicality or necessity, I believe it misses the larger picture issue of why herbaria are essential to the study of biology. The rationales for "getting rid of" herbaria are often different at the departmental and administrative level, but when the decision is made to divest an institution of such a resource, both the department and the administration must take responsibility for the decision.

At the departmental level, the reason to divest is often based upon an appraisal of the field of systematics or an appraisal of what constitutes a biology curriculum. I have argued that morphological systematics is, and will continue to be, a critical aspect of systematics, but it seems that many departments base their understanding of systematics on outmoded concepts of "stamp collectors" and not on modern systematic theory and practice. Many departments have decided that computer modeling in ecology and DNA sequencing in molecular biology have made organismic biology obsolete. These ideas have merit in that these fields are making significant progress, but they are completely wrong-headed in underestimating the value of systematics to biology, and the value of using organismic biology as a fundamental underpinning of the study of life.

At the administrative level, the reason to divest is often based upon considerations of space and funding. One underlying reason for these decisions is the post-Sputnik policy of the U.S. government to support universities by allowing them to charge granting agencies for "overhead". The high price academia has paid for this financial assistance comes largely in hiring and tenure decisions made on the dollar amount the professor may be able to bring to the institution. This results in biology departments that are "cash cows" for the university, but that are neither doing a good job at helping students learn about biology, nor adequately training the scientists of the future. Compare this to the level of university curricula, where we expect a student to take such courses as English, History, or Statistics, and we provide space and support for these areas even though they are not generally the "high dollar" grant-getters in the university.

It is my argument that the faculty and administration of an institution of higher learning have, as their highest obligation, a responsibility to maintain a learning environment. When resource allocation decisions are based upon funding potentials, or outmoded perceptions of various fields, the field of science is the real loser in not training students to be prepared for the future. It is up to us as scientists to educate other scientists, as well as administrators, to help them understand the value of organismic biology. Herbaria are the "coal mine canaries" of organismic biology, and as they go, so goes a major component of our search to unlock the puzzles of life.

TAXONOMY: ONE KIND, OR MANY?

C. RITCHIE BELL

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Dr. Bell received the A.B. and M.A. degrees from the University of North Carolina in 1947 and 1949, the Ph.D. degree from the University of California at Berkeley in 1958, and was with the U. S. Army Air Force from 1942 to 1945. He was employed as Instructor in Botany at the University of Illinois, 1953-1955, and as Assistant Professor at the University of North Carolina from 1955 to the present. Dr. Bell is a member of the Botanical Society of America, the Society for the Study of Evolution, the International Society of Plant Taxonomists, and others. He is the newly elected secretary of the American Society of Plant Taxonomists. Dr. Bell's current research is on the flora of the Carolinas and on the cytology of the Umbelliferae. The latter project will involve a four-month trip this summer and fall to Central America for collections in this group.

For the purposes of teaching, taxonomy can be, and usually is, divided into several sub-categories, each of which deals with a particular aspect of taxonomy. Often an entire course is devoted to a single one of these specialized aspects. Thus there are courses dealing primarily with the morphology of flowers and other plant parts, with plant evolution, with phylogeny, with the identification of plants - usually the plants of a small geographic area at one season of the year, or with the nomenclature of plants. So vast is the recorded knowledge and detail of each of these categories that no course, or series of courses, could cover in entirety all of the pertinent material within its scope. Thus there is always more to learn, and each of these individual courses tends to become an end in itself. Furthermore, some of these courses often come to be called "Taxonomy" courses, with the expected result that some people may be prone to regard the subject matter of any one of these courses as taxonomy. Soon after, we begin to hear of *kinds* of taxonomy and of course, kinds of taxonomists.

Gross morphology (the standard phrase, anything visible with a hand lens of no more than 10X power", can well serve for a definition-here) is the very foundation of plant classification; it is only slightly less important in the study of plant relationships. But certainly it is not to be assumed that morphology, regardless of its basic nature in many areas of biological study, is synonymous with taxonomy. Nor can such special subjects as evolution, phylogeny, plant identification, or nomenclature be considered as synonyms for taxonomy. These are all-subjects which, to some, may be complete within themselves; they are also subjects which serve collectively as the tools of taxonomy. These individual tools should not be equated with the science in which they are used.

However, unlike the teaching of taxonomy, taxonomy in practice cannot be subdivided into kinds of taxonomy. If every available tool is not used in the solution of a taxonomic problem, the taxonomist's work is incomplete and open to questions other than those of interpretation. In some cases involving plants from inaccessible areas of

the globe, adequate material for definitive work may not be physically available to the taxonomist. In such cases one must do the best job possible with the material available and should acknowledge the relatively incomplete nature of the work. Taxonomists who realize the difficulty of such necessary pioneer work can make allowance for future revision. No allowance should be made, however, for work that is incomplete because certain ideas or taxonomic methods are, either from training or preference, unacceptable or mentally unavailable to the taxonomist.

Taxonomy, in practice, *can* be divided into steps, but to say that the first step -- Morphological Taxonomy, Classical Taxonomy, Traditional Taxonomy, or Alpha Taxonomy -- is also the last is just as wrong as saying that the second step -- Biosystematics, Cytotaxonomy, Chromosome Botany, or Beta Taxonomy--- is both the alpha and omega of taxonomy.

Ideally, the result of the taxonomist's work serves two purposes: it facilitates plant identification and indicates relationships. The "Classical Taxonomist" who today uses only

gross morphological features in problems of identification and relationship is only half a taxonomist. His work will usually enable one to place a name on a particular specimen, but in many cases data from hybridization or cytological studies can give a far more definite answer to questions of supposed close relationship than could be had from an endless amount of petal measuring or stamen counting. Conversely, the "Biosystematist" who uses only such things as chromosome behavior and statistical studies in taxonomic problems is only half a taxonomist. His work may indicate relationships but without permitting the necessary identification of individual plants. No amount of chromosome counting and statistical analysis will yield as accurate and useful a species description, or identification, as can be had from critical morphological studies.

Taxonomy is a single phase of biology. It cannot be divided into *kinds*, but it can be divided into *steps*. Thus there cannot be two kinds of taxonomists. It is to be hoped that all taxonomists will take all steps in their work whenever possible.

REVIEWS

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Samways, Michael J. 1995 Insect Conservation Biology. Chapman & Hall, London \$29.95. 358p

Both the lay public and applied entomologists have for years associated the term "insect" with the term "pest"; the focus has been not on conservation but on suppressing, or even eradicating, a limited number of damaging species. With such a perspective, the concept of insect conservation would appear almost oxymoronic. *Insect Conservation Biology* is intended as an introductory text to emphasize how fundamental insect conservation is "...not only to biodiversity conservation, but also to sustainable agriculture and a sustainable biosphere". The book is aimed at a broad audience, from land managers to entomologists, both amateur and professional, and

forms part of a series on conservation biology which is intended to serve as readable reference works for conservationists.

The volume is divided into four major sections: introduction, levels of analysis and conservation, the dilemma of pest control vs. conservation, and suggestions for future action. Each chapter in a section begins with a 19th century black-and-white insect drawing and one or more apt quotations; these are a delight. Chapters are divided into sub-headings followed by sub-sub headings (e.g., 1.5.3); this attempt at conceptual organization at times serves merely to separate single brief paragraphs, hindering rather than enhancing the reading experience. Each chapter concludes with a thorough and useful summary. The book also provides an extensive 35-page reference section, and an adequate index.

The first part provides introductory material for readers of varying backgrounds, and is perhaps the least successful. The chapters on insect biology and environmental issues attempt to condense far too much background information into too little space, and are difficult reading. The figures, taken mainly from primary literature sources, often lack sufficient text or caption explanations to be useful to the non-specialist. However, the reader should not be discouraged by this initial encounter, but should continue reading. The final chapter in this section, a history of insect conservation biology, begins to give a idea of the well-researched and informative material to come - the anecdote about Thomas A Becket's deathbed lice is, alone, well worth the price of the book!

The second, and longest, section deals with insect conservation at various levels, from single species to large-scale ecosystems, from the polar regions to the tropics. Problems of fragmented and disturbed landscapes are covered, with necessary emphasis on agriculture, urbanization, and conservation reserves. Definitions and concepts, particularly those relating to landscape ecology, are very clearly explained, and the integration of figures into the text is improved compared with the first section. The author, a South African entomologist, draws heavily throughout the book from his own extensive body of research. His unique perspective, and his knowledge of the Cape fauna and flora, provide an excellent balance between north and south temperate zones not usually found in ecological texts. Comparisons and contrasts drawn between these two temperate regions add considerably to the breadth of the book. Treatment of the tropics is comparatively less thorough, and occasionally superficial.

The third section deals with the dilemma of trying to reconcile insect pest control and insect conservation, and is directed primarily at applied entomologists. Pesticides, pathogens, inundative releases of parasites and predators, and classical biological control are considered in chapter 8. Advantages and disadvantages of the latter approach, which involves the importation of a natural enemy to control an exotic pest, are assessed for both insect and weed control. The author's perspectives on classical biocontrol and insect pathology are not those of mainstream entomologists; he is highly critical (perhaps rightly) of early biocontrol efforts, from the standpoint of environmental interference, and he virtually condemns all insect pathogens (viruses, bacteria, protozoa, fungi, nematodes) as "biopesticides". Chapter 9 covers bioethics, from a single, sadistic human pulling the wings off flies to the Gaia concept, and emphasizes again the importance of conservation of ecosystems and landscapes which is the major theme of the book. The concluding section covers the role of

insects in landscape conservation as indicator species and components of diversity indices, and discusses restoration, captive breeding, genetic preservation, and other techniques for the future. The outlook of the book is upbeat and optimistic.

Although the intended audience ranges from conservation students to professional entomologists, *Insect Conservation Biology* will work best as a text to introduce entomologists to concepts of insect conservation, rather than the reverse. For the novice, explanations of landscape ecology seem more basic, and easier to understand, than those pertaining to entomological material; environmental scientists, conservation biologists, and land managers will profit from reading the book, but will need a good introductory entomology text nearby for reference.

PAULA LEVIN MITCHELL, *Department of Biology, Winthrop University, Rock Hill, SC 29733*

Benz, G. W., and D. E. Collins (eds.) 1997. **Aquatic Fauna in Peril: the Southeastern Perspective.** Southeast Aquatic Res. Inst. Spec. Publ. 1, Decatur, GA. \$45 + S&H, hardbound. 554p.

Man in his rush to live near water has slowly or suddenly become aware that there is something amiss in the nation's streams, ponds, lakes, and their faunas. He asks: where are the hoards of mayflies and caddis flies that used to splatter car windows; where are the soft-shelled, recently molted, freshwater crayfishes he propped in a clear freshwater stream at night so he could use them as bass bait; and what has silenced the creaks, peeps and croaks of spring peepers and bullfrogs once so common on a summer night? They seem to be gone from our nation's and southeastern aquatic habitats.

Aquatic Fauna in Peril, the Southeastern Perspective, sponsored by the Tennessee Aquarium and the Southeastern aquatic research institute, is the result of a conference held in Chattanooga, Tennessee 31 March-1 April 1994 that brought 242 concerned scientists together to discuss the plight and fate of the southeast's aquatic fauna, many of which are now considered threatened, endangered, or extirpated. Forty-one contributed papers have been molded into the 17 chapters that comprise this volume.

Four color habitat photos are on the front cover. A state stream map of the southeast spans the inside front cover. A beautiful color photo of the crayfish *Cambarus fasciatus* is found just inside the title page of this 554 page book. A color plate of four darters, found in the Etowah River is found on p. 388. A color photo of the plain pocketbook mussel, *Lampsilis cardium*, with its extended minnow-like mantle flap, used to lure fishes that will serve as nursery for its young, is found on p. 583. Ray Anderson's color mural of stream life straddles the inside back covers.

The southeast, according to the editors, is that region of the United States comprised of the states: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, North Carolina, South Carolina, and Tennessee. However, each chapter author seems to have his or her own definition of what constitutes the southeast. State and fate of the world's aquatic faunas introduce this book. This is followed by chapters on: aquatic insects, mollusks, fishes, amphibians, reptiles, birds, and aquatic mammals (Chapters

2-9). To me, chapters 10- 15, which deal with the same groups but with management themes, are out of place as they should each have followed subject groups noted in Chapters 2-9. That way one learned of the problems of a group, *i.e.*, fishes, and then was exposed to how to help, manage, or restore the affected organism or group. Chapter 16, on the Etowah River status and restoration seems also out of place. It should have followed Chapter 5 re: fishes. Chapter 17 treats management and conservation of aquatic resources.

Seven general appendices to threatened and endangered species, by state, *etc.* occupy pg. 469-499. A general subject index is found on p. 503-513, a common names index p. 515-530, and a taxon index p. 533-551. Why 14 pages: 468, 486, 489, 490, 492, 496, 500, 514, 531, 532, 552, and 554 are left blank is unexplained.

Throughout the volume, each presenter sounds the alarm that their respective group is in trouble (lists of threatened and endangered species are presented). They note that there has been a giant failure to educate the public that the reasons some animals need protection or have been drastically affected all point back to man's tampering with the aquatic environment by damming the stream, increasing siltation, cities and farms runoff polluting waters, logging, urbanization, *etc.* Most of the southeast's rivers, *etc.* have been affected since man appeared on the scene. The southeast contains the majority of the aquatic species and fauna of the United States. Great endemism occurs in the region, especially in the Tennessee and Alabama region. Twenty percent of the fish faunas are in jeopardy as are 90% of the mollusk and crayfish faunas. Restoration has been suggested by all authors that we need to take an ecosystem approach rather than expending efforts in relation to just one species, one area, one stream, *etc.* There is little that can be done to return habitats to their once pristine conditions. More importantly, few citizens want to be affected or taxed in order to see such restoration or protection.

Scientists on one hand are striving to restore or protect a group or an ecosystem, while on the other hand developer greed and human population growth are contributing to faunal demise. Even educational institutions are chasing genetics, DNA, and applied monies and are shunning the training of field and systematic scientists by shifting their emphasis from basic to applied sciences. Also, they will realize, all too late, that when we inventory the southeast and the nation, there will be few or no scientists available who are competent and can identify a: dwarf wedgemussel, Alabama cave shrimp, boulder darter, red hills salamander, or Florida salt marsh vole.

This is a well written and jam packed volume. The paper is heavy coated for endurance. The only errors I found were: *Phenognathus herbrichti* (p. 308) is not italicized; manatees do reach New York; and *Cambaras fasciatus* is not in the index.

The volume establishes a data base that records the present southeast's aquatic fauna in peril. We should all become active and see that legislation doesn't let more development and water quality degradation to occur. If that happens, the efforts and dreams of all scientists and concerned citizens will continue to see the southeast's fauna depleted and a memory.

FRANK J. SCHWARTZ, *Institute of Marine Sciences, University of North Carolina, Morehead City, North Carolina 28557-3209*

Bradbury, Jack W., and Sandra L. Vehrencamp. 1998. **Principles of Animal Communication**. Sinauer Associates, Inc. Sunderland, MA. \$62.95. 882p.

No previous volume has provided such a thorough review of the "how"s and "why"s of animal communication. The authors, both field workers with enviable records in behavioral ecology, should be applauded for providing biologists with a thorough introduction to both the physics and the theory underlying animal communication. They provide the reader with a glimpse of the sensory environment (or to use the term of the early ethologists, the Umwelt) that acts as a selective pressure on information transfer among animals. The value of studying the proximate underpinnings of behavior, for which Niko Tinbergen, Konrad Lorenz and Karl von Frisch, received the Nobel Prize in 1973, has recently been rediscovered by behavioral ecologists (e.g. studies of ultraviolet reception in birds and insects, olfactory mate choice in amphibia and mammals, etc). The audience for this book should not restrict itself to the behavioral ecologist, however. The great power of this book is that it tackles animal communication in an interdisciplinary manner. As the authors note in the Preface, their undergraduates at UC-San Diego particularly enjoyed the subject because it integrated all their other courses including chemistry, physics, mathematics, and economics. I should caution the reader that the text can be quite mathematical in places, particularly if you haven't done any algebra recently. For this reason I would recommend that unless the students are particularly well-prepared, this text should only be used for highest level undergraduate courses or for graduate-level instruction.

The text begins with a brief introduction to the general topic by defining communication. The introduction is followed by chapters dealing, with the physics of signal production, and the means of signal analysis. The second set of chapters examines how signallers and receivers attempt to optimize information transfer. Both the first and second parts of the book are unique resources in which much disparate information is brought together so that sensory modalities can be compared and contrasted. The final section overlaps to some degree with other texts that take a game theory approach to behavioral ecology. All chapters include a broad range of examples from a variety of invertebrate and vertebrate taxa.

No doubt natural scientists of any ilk will find the chapters fascinating and valuable reading. It is chock full of explanations for things you have always wondered about. In addition *Principles of Animal Communication* provides excellent introduction to the tools for researching puzzles of animal communication, should the reader decide to begin studying signalling in animals. Also it can be used to inform the lecture content of non-behavioral courses, such as ornithology, mammalogy, entomology, comparative physiology, and evolutionary biology. Every biologist should have this text on their shelf as a reference, there is no other like it.

RICHARD BUCHHOLZ, *Department of Biology, Northeast Louisiana University, Monroe, LA 71209-0520*

Primack, R.B. 1998. **Essentials of Conservation Biology**. Sinauer Associates, Inc. MA. \$49-95. 660 p.

Dr. Primack, professor and associate director of the Environmental Studies Program at Boston University, has updated *Essentials of Conservation Biology* (2nd edition) in an effort to capture rapid developments which have taken place in the field of conservation biology since 1993. In keeping with the author's premise that the science of conservation biology is most effective when the principles of the science are understood by a wide audience, *Essentials* has been translated into Japanese and Indonesian with Vietnamese and Chinese translations being planned. The book's organization and level of detail make it well suited for use as a primer on the subject. The author includes more than enough information and discussion of the fundamentals to enable readers to consider the many facets of the more advanced subject material presented later in the text.

The book is organized in to six parts: major issues that define the discipline (chapters 1-3), valuing biodiversity (chapters 4-6), threats to biological diversity (chapters 7-10), conservation at the population and species levels (chapters 11-14), practical applications (chapters 15-19), and conservation and human societies (chapters 20-22). The first three sections provide a broad base introduction to the science and many of the most significant issues practitioners can expect to encounter (eco-economics, non-consumptive use valuation, actual and functional extinction threats, habitat destruction and degradation threats, overexploitation, and the impacts of exotic species introductions and disease). After establishing the basic concepts and issues, the author moves into more technically advanced presentations of conservation. Section four of the book delves in to the various levels at which the principles of conservation can be applied and thoroughly discusses the advantages and drawbacks of the various approaches. Through highlighting the dysfunctional aspects of small populations, the author presents a sound case that the preservation of minimum viable populations (MVPs) is the key to preserving species. After establishing the MVP position, the author examines the many facets to be considered in the selection, protection, and propagation of MVPs (minimum dynamic area, genetic diversity, extinction vortices, indicator species, viability analysis, population monitoring, and *in-situ* and *ex-situ* preservation strategies). The final two sections of the book serve to point out the reasons why the conservation of biological diversity is, and must be, a multi-disciplinary effort. The fifth part of the book highlights the issues, tools and techniques associated with the planning, establishment, maintenance, and monitoring of protected areas. The final part of the book examines the inevitable and necessary interfacing of conservation projects with human populations through the presentation of successful and failed integration strategies (sustainable development, eco-colonialism, extractive reserves, habitat protection treaties, and development banks and other multi-national conservation organizations).

The hard bound book, which has a unique cover highlighting a painting by Michael McNelly, has text which is easily read in most instances and is rich with case histories and other examples of the main discussion points. The author augments the main text with topic boxes which serve to tie the conceptual discussions to real world examples. The book uses over 230 black and white figures, tables, and graphics to further highlight significant points in the text. Each chapter is concluded with a brief chapter

summary, points for discussion, and a list of suggested readings. The book itself is concluded with an Appendix of selected environmental organizations and sources of information, a bibliography, and a subject index.

In summary, the book would be an excellent primer for audiences interested in entering, or simply learning about, the field of conservation biology and Biodiversity.

DAVID VAN GRIMES, *Virginia Department of Environmental Quality, Richmond, VA 23219.*

Beacham, W. (ed.) 1997. The World Wildlife Fund Guide to Extinct Species of Modern Times. Beacham Publ. Corp., Osprey, FL. Vol 1. \$55.00 hardcover, 410 p.

Volume 1 of this new series from Beacham Publishing offers additional reference material for people interested in the problem of biodiversity loss. This volume covers extinct birds of North America and the Pacific Islands, plants of the Hawaiian Islands, fishes of North America, and mammals of North and South Africa, North America, and the Atlantic islands. The book is produced in the same quality and page size (7x 10 inches) of others by this publishing company. Species accounts are grouped into geographic units, such as Madagascar, Mascarene, and the Seychelles and the Caribbean Islands. The geography and causes for extinction are reviewed for each section, followed by individual species accounts. The format of these accounts are similar to those in Beacham's other books with subsections on description, behavior, habitat, and causes for extinction. Each account is "Adapted from data compiled by the Threatened and Endangered Species Information Institute (Golden, CO) for Beacham's International Threatened, Endangered, and Extinct species published on CD ROM." The information presented in each account is well written and covers 2-3 pages, including a map of the area. There is a section on illegal trade in endangered species, 38 color plates of selected species from color illustrations and photos, a 30 page toy glossary two drawings of fish anatomy, and an index to common and scientific names.

I am concerned most with the lack of bibliographic citations in this book. It has none. Books like this should stand alone as a reference source for a library or on a teacher's shelf. One should not have to go to an expensive companion CD ROM to find the literature citations. It would have not taken up any more space to include key references for each of the species. And, frankly, I would have been interested in the primary literature citations for my classes. Secondly, many of the insert maps included with each account are almost useless. Maps are included only to show the general geographic area. Lack of detail for geographic place names is commonplace in publications about endangered species, but these are extinct species and I cannot understand why more detailed maps were not included.

Other than these concerns, I found volume 1 on extinct species to be useful and informative. The price is reasonable for a hard cover book of this size. This volume

should join others from Beacham on public and university library shelves throughout the country.

JOSEPH C. MITCHELL, *Department of Biology, University of Richmond, Richmond, VA 23173.*

Dawes, C. J., 1998. **Marine Botany**. 2nd ed. John Wiley & Sons, NY. \$ 79.95. 480 p.

The first edition of this treatise appeared in 1981 and was based on lectures given by the author at the University of South Florida since 1965. The need for a text on the wide variety of marine plants is obvious. There are excellent books dealing with individual topics, such as coral reefs, mangroves, salt marshes, seagrasses, and seaweeds, but none using a comparative approach for all of them. In the present edition the theme connecting the multitude of marine plants, viz. ecology, is again emphasized. The first five chapters explain classification, nomenclature and habitats of marine plants, abiotic, and biotic factors, as well as physiological ecology, and anthropogenic influences on the communities. The following seven chapters provide an introduction to macro- and microalgae and their communities, to salt marshes, mangals, seagrasses and their communities, and to algae of coral reefs. Selected methods and uses of algae are added as appendices. Compared with the previous edition, discussions on seaweed taxonomy have been somewhat reduced, whereas chapters on communities, dealing with adaptations, ecology, and resource management have been expanded. The chapter on human effects on marine plant communities has been considerably increased, including the role of introduced exotic marine plants, ultraviolet light, global warming) and changing sea levels.

The goal of Dawes' revision, is ". . . to present taxonomic, physiological, chemical, and ecological aspects of marine plants, their adaptations, and how abiotic and biotic factors interact in their communities." The author has certainly reached this goal and produced a treatise that will be indispensable for upper level undergraduate and graduate courses in marine biology, phycology and general field courses. It should be very useful also for specialized high school and junior college courses. The book is beautifully illustrated; in particular noteworthy are the habit sketches by Mrs. L. Leatherwood of algae, marsh plants, mangroves and seagrasses. The halftones are, with few exceptions, excellent. Unfortunately, the generally positive impression of the book is somewhat marred by the large number of printing errors (at least 10 percent of the pages contain one or more). Although the author clearly states (on p. 168) that "The blue-green algae (Cyanobacteria) belong to the Eubacteria. . ." he almost consistently uses the outdated term blue-green algae throughout the book. This practice is inadvisable, in particular in a treatise to be used by many inexperienced students.

Finally, I would like to make a suggestion for future editions of "Marine Botany," namely, to include discussions on the role of fungi. The index in the present book lists only one entry for 'fungi,' and the corresponding page shows them only as components of Whittaker's five kingdoms system. In fact, fungi are more important than bacteria as decomposers of marine plants (e.g., Newell, 1972; Newell *et al.*, 1989), and also

occur as significant parasites and symbionts. In spite of diverse books on this subject (e.g., Johnson and Sparrow, 1961; Kohlmeyer and Kohlmeyer, 1979; Moss, 1986) and numerous articles in a wide variety of journals, modern marine textbooks still tend to ignore the role of fungi which are the largest group of organisms after the insects (Hawksworth, 1991). It is characteristic that *Ascophyllum nodosum*, one of the most frequently mentioned algal species in this book, is not even characterized as phycobiont of an obligate symbiosis with a systemic ascomycete (*Mycosphaerella ascophylli*). Aside from these criticisms, "Marine Botany" can be highly recommended as an important tool for teaching and research.

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JAN KOHLMAYER, *Institute of Marine Sciences, University of North Carolina at Chapel Hill, Morehead City, NC 28557.*

Barnes, Jay. 1998. North Carolina's Hurricane History, Revised and Updated Edition, The University of North Carolina Press, Chapel Hill, NC. \$34.95 (cloth), \$18.95 (paper). 256 p.

This book is primarily an historical account of hurricanes affecting the North Carolina coast. The new edition brings the book up-to-date with the inclusion of two significant hurricanes that hit North Carolina during 1996. Chapters 1, 2, and 3 discuss general attributes of hurricanes and include some physical explanations for their formation and growth. Aside from the opening chapters, the book mostly steers away from the scientific aspects of hurricanes. For those interested in a more scientific treatment of the topic I would suggest Roger Pielke's clearly written and highly accessible 1990 book, *The Hurricane*.

Barnes' historical review begins in Chapter 4 with hurricane experiences of early European explorers along the North Carolina coast in 1594. Information on storms during this period is sparse, but the author manages to piece together the available facts and account for a surprisingly large number of storms. The main section of the

book is contained in Chapters 5, 6, 7, and 8, which document on a storm-by-storm basis North Carolina hurricanes from 1876 through 1997. More coverage is given to recent storms. Information such as wind speeds, storm positions and duration, and water levels are given along with descriptions of the resulting property damage and fatalities. Woven in with the bare storm statistics, Barnes retells the experiences of the survivors. Chapter 9 is devoted to Nor'easters (extra-tropical low pressure systems) and Barnes notes their many similarities to hurricanes. Chapter 10 gives a brief discussion of the effects of hurricanes on animals. Chapters 11 and 12 provide information on preparing for a hurricane. The book concludes with an appendix containing several tables and graphs that give quantitative comparisons between the most significant hurricanes.

The main difference between the new edition and the original edition is coverage of hurricanes Bertha and Fran that hit the North Carolina coast in 1996. Of the 50 additional pages in the new edition, 42 are dedicated to these two hurricanes. The remaining differences are minor, involving small changes to the text and some alternate photograph selections.

The best part of the book is the extensive collection of historical photographs. Barnes has done an impressive job of assembling nearly 200 pictures and photos from newspapers and private collections. Many of these photos are from storms in the early part of this century and I found them fascinating. For less than twenty dollars the book is a good value and is written to appeal to a broad audience. North Carolina natives will appreciate the local details in the text, while those who live away from the U.S. Atlantic coast will likely be amazed by the consequences of these tremendous storms, which this book documents quite well.

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*Bolen, Eric G., 1998 . **Ecology of North America.** John Wiley & Sons, Inc. NY. \$79.95. 448 p.*

Eric Bolen has written an interesting book with a presumptuous title, but one definitely worth having in your library. Acknowledging his debt to Victor Shelford's treatise with the same name, Bolen notes that his text is aimed primarily for the undergraduate who may or may not have had any prior experience with the ecological regions of North America. It is therefore, by design, limited in size and scope, and written with the idea that it would serve as an *introductory* text, rather than an extensive reference tool. States Bolen "Given my intent, a book of this type represents a balancing act between generalities and detail - just as it does for the choice of content". I think the author has succeeded in writing a wonderful introductory text and yet has managed to pull together enough information to make this book of interest even to those of us with years of experience in the field. I mean, how many of us would have considered the importance of buffalo chips to the ecology of the great plains? Or that jojoba oil has similar properties to sperm whale oil, and played a role in preserving sperm whales? These, and other ecological anecdotes, adorn this book.

In truth, this book is basically a descriptive compilation of the biomes and communities of North America, with certain ecological concepts added on when necessary to explain particular processes in each of the biomes addressed. Each chapter follows a similar yet flexible format; introduction, soils, interesting features, communities within the biome, plants and animals of interest, and any other interesting aspects of the ecology. What helps to make the book readable, besides Bolen's gift for clear and concise writing, is the absence of distracting references to published works within the text itself. Given the instructional level for which this book is intended (sophomore level, according to Bolen), such sidelights tend to break the train of thought, are of little use to these students (especially if they are non-majors) and they make the text less a story and more so a dry, plodding, scientific journal article. However, Bolen does include a wealth of references at the end of each chapter, sorted by topic, which interested readers can pursue if they so desire. In addition, Bolen adds commentary to each reference to let the uninitiated student know, for example, which papers are classics in their field, and which have had major impacts in ecology.

The book opens with an overview chapter that discusses successional theory, species richness gradients, distributional patterns, and a variety of ecological rules, such as Bergmann's and Allen's. New terms are introduced throughout the book in boldface type, and can be looked up in a glossary at the end of the book, although most are explained quite well in the text itself. In addition, measurements are given in metric units, although for the metrically impaired, the non-metric equivalent is placed in parentheses. Most of the major biomes in North America are covered, while smaller and more special environments are lumped together in a final chapter (*i.e.*, Atlantic tidal marshes, cliff face communities, caves, mangrove thickets, and so on).

I won't detail each chapter covered, but I will mention some notable highlights. In Chapter 2, Tundra, there is an excellent discussion of tundra soils and soil patterning, and the proximate causes of those patterns. This is one of the best collations of material on this subject, and is especially noteworthy because of the style and clarity of writing. I was fascinated by this section. Bolen also does away with the folktales regarding lemming suicide, and instead discusses this subject from an objective viewpoint, pointing out why this tale got started in the first place, and why it doesn't make ecological or evolutionary sense were it to have been true. The discussion of treeline, and its multiple causes, is one of the best to appear in recent years.

The chapter on boreal forests is generally well done, but I do have some caveats to pick here (perhaps reflecting my research biases). Bolen mentions spruce-fir occurring above 5000'. I think in the southern Appalachians you can find it as low as 4500' (okay, I'm quibbling!). More seriously though, Bolen submits to the very controversial idea that acidic deposition has caused much of the decline in forest health at these high elevations. In the southern Appalachians, this is a much debated point. Most of the spruce are not in decline, while over 90% of the fir have died from an introduced adelgid, and not acid rain. Surprisingly, Bolen doesn't even mention the adelgid. In addition, fir forests worldwide undergo a form of succession known as wave regeneration, where dying firs move through the years in waves across the mountain slopes. These fir waves are a natural phenomenon, and unique to these particular ecosystems, and, most important, are often mistaken for pollution damage. Failure to mention this, even given Bolen's qualifying statements on choice of content, was, I think, a mistake. On the positive side in this same chapter, I found it interesting to

INSTRUCTIONS TO AUTHORS

The *ASB Bulletin* invites submissions of research articles for publication in the *Bulletin*. The submissions should be of high quality and of interest to a broad spectrum of biologists. To submit a report for publication the author(s) should include the following:

1. A cover letter signed by all authors of the paper indicating a desire to publish the paper in the *ASB Bulletin*.
2. Three paper copies of the submitted article and one copy submitted on computer disk in either WordPerfect (no higher than version 8) or in an ASCII file. The use of other word processors are acceptable, but contact the editor.
3. Two glossy copies and one photocopy of each photograph to be published, each with appropriate labeling.
4. The names, addresses, telephone numbers and e-mail addresses of four researchers who would be qualified to review the paper.

Articles should generally include introduction, materials and methods, results, discussion and literature cited sections. Obviously, certain types of articles may not lend themselves to that format and exceptions can be made for those papers. Citations should be of the author & date style (check *Genetics*, *American Journal of Botany* or *Animal Behavior* for examples.)

Research articles are published once each year in the *ASB Bulletin* an issue usually published in November. Articles accepted two months before the publication date will be published in that year.

The first ten pages published in one year are free to members of the Association of Southeastern Biologists. Thereafter a page charge of \$60 per page is assessed. Non-members must pay \$60 per page. No color photos can be published.

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POSITION AVAILABLE**COMPARATIVE VERTEBRATE MORPHOLOGIST**

Assistant Professor, Tenure Track
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CONTENTS

THE *ASB* BULLETIN VOLUME 45, NUMBER 4, DECEMBER, 1998

ISSUES IN BIOLOGY	187
VERTEBRATE COLLECTIONS AT SMALLER SCHOOLS - GOOD OR BAD PART 1	
DR. WAYNE VAN DEVENDER	188
ORPHANED HERBARIA SHOULD BE UNITED WITH LARGER HERBARIA	
ROBERT R. HAYNES	191
WHAT IS THE FUNCTION OF A HERBARIUM IN A DEPARTMENT OF BIOLOGY	
AT COLLEGES AND COMPREHENSIVE UNIVERSITIES?	
ZACK E. MURRELL	194
COMMENT ON POSITION TAKEN BY ZACK MURRELL	
BY ROBERT HAYNES	198
COMMENT ON POSITION TAKEN BY ROBERT HAYNES	
BY ZACK MURRELL	199
TAXONOMY: ONE KIND, OR MANY?	
C. RITCHIE BELL	200
REVIEWS	201
INSTRUCTIONS TO AUTHORS	213
POSITION AVAILABLE	214

Cover photo - Dr. Dwayne Wise, Department of Biological Sciences, Mississippi State University,
 Starkeville, MS 39762-7939

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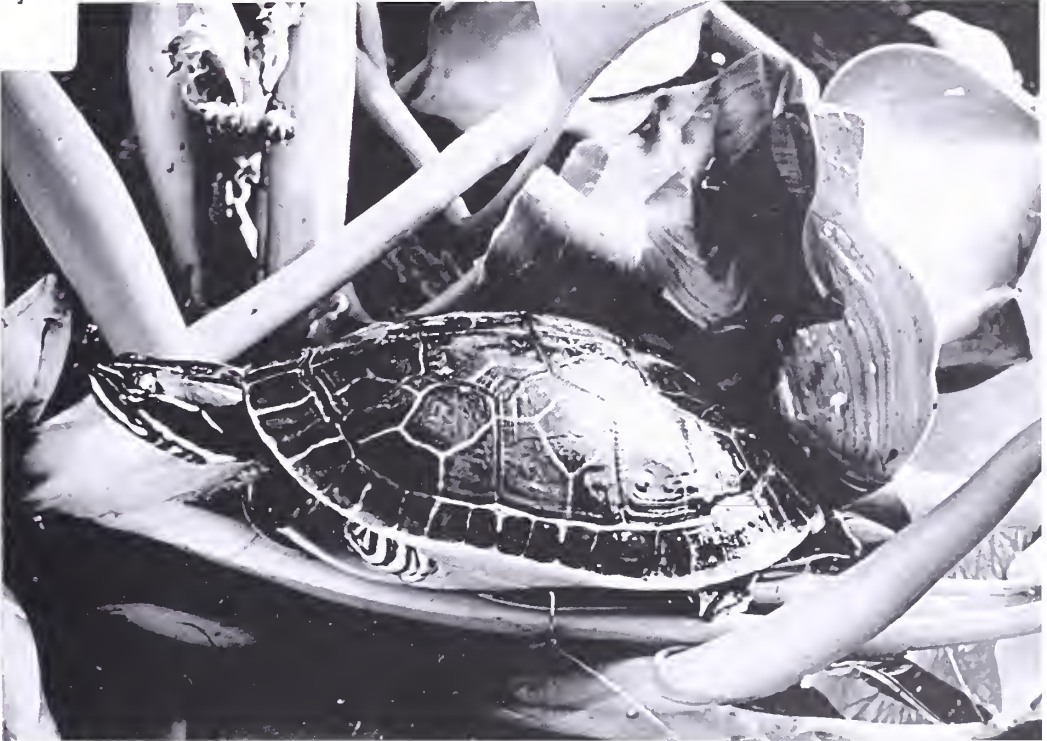
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The *ASB* BULLETIN

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January, 1999

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Chicken Turtle *Deirochelys reticularia*, family Emydidae

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PURPOSE

The purpose of this association shall be to promote the advancement of biology as a science by encouraging research, the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. Members receive the *ASB Bulletin*.

TIME AND PLACE OF FUTURE MEETINGS

1999	April 14-17	University of North Carolina at Wilmington, Wilmington, NC
2000	April 5-8	University of Tennessee at Chattanooga, Chattanooga, TN

NEW LOGO

Below you will find the new logo for the Association of Southeastern Biologists. It is very similar to the old logo, but the state lines are extended to the states bordering the traditional states that have been represented. This is to indicate that ASB is more than a regional society, and has many members in other states and some foreign nations. The new logo indicates inclusiveness for these members and acts to invite biologists in these areas to join us. The logo will also be found on the back cover of each issue of the *ASB Bulletin*, starting with this issue. ASB is indebted to Dr. John Herr for his excellent work on the new logo.



60th ANNUAL MEETING IN WILMINGTON, NORTH CAROLINA

The University of North Carolina at Wilmington (UNCW) and the Department of Biology welcome the Association of Southeastern Biologists to Wilmington, North Carolina for the 60th annual meeting, April 14-17, 1999. All activities except the Thursday evening social and field trips will be held at the Wilmington Hilton Hotel and at the adjacent Coastal Convention Center in downtown Wilmington.

Societies Meeting with ASB in Wilmington

American Society of Ichthyologists and
Herpetologists, Southeastern Division (ASIH)
Beta Beta Beta (BBB)

Botanical Society of America, Southeastern Section (BSA)
Ecological Society of America, Southeastern Chapter (ESA)
Society of Wetland Scientists, South Atlantic Chapter (SWS)
Southeastern Fishes Council (SFC)
Southern Appalachian Botanical Society (SABS)

UNCW and WILMINGTON

Wilmington, North Carolina is a seaside port-city with a population of about 70,000 people. Its location, along the bank of the Cape Fear River in the southeastern part of North Carolina about 25 miles inland from the Atlantic Ocean, influenced this city to be a receptacle for early European settlers, eventually becoming a beautiful cosmopolitan city with a southern flavor. Wilmington is the seat of the New Hanover County which is well known as a summer resort with many beaches including the picturesque Wrightsville Beach. The city is about 135 miles southeast of Raleigh, the capital of North Carolina. Founded in 1730 as New Liverpool, later called New Town, it was named Wilmington in 1734. The city was the first to offer armed resistance to the Stamp Act, eight years before the Boston Tea Party. In 1781 and 82 Wilmington was occupied by the British under English general Charles Cornwallis who lived in downtown. The Cornwallis headquarters is still a historical monument, not too far from another historical monument and museum, the U.S.S. *North Carolina* which fought in World War II. The historic town of South Port at the mouth of the Cape Fear River and the adjacent Bald Head Island with its light house are interesting sites to visit. Two other attractions in the Wilmington area are the North Carolina Aquarium and the Fort Fisher Museum. Located along the rim of Greenfield Lake, just a mile from the 1999 ASB venue, is the Community Five-Mile Drive with flowering plants, tall trees and swimming ducks. Wilmington is the home of the University of North Carolina at Wilmington.

The weather in April should be mild, with the air temperature in the 70's but the mercury in the thermometer can plunge as low as the 50's. Rain gear is wise to have when you visit this town which experiences rather unpredictable weather in the spring. The ASB meeting is scheduled here just a week after the famous Azalea Festival which brings celebrities from all over the nation to Wilmington at a time all the azaleas are in bloom everywhere in this good old town. Swamps, saltmarshes, sandy beaches and the coastal plain studded with loblolly and long-leaf pines trees with turkey oaks make up the scenery around Wilmington. You may see blue jays, cardinals, squirrels, or a spotted deer in the woods if you drive the less-frequently traveled roads around Wilmington.

The University of North Carolina at Wilmington (UNCW), located on a 600-acre campus near the sea, is one of the sixteen constituent institutions of the UNC-system and is headed by a chancellor. It is a comprehensive level I university dedicated to excellence in teaching, in scholarly and artistic achievement and in service to regional and global communities. This university recognizes the importance of the traditional liberal arts undergraduate teaching mission, while at the same time offering a wide spectrum of graduate studies that complement its undergraduate programs. The university's location in an historic Atlantic seaport provides special opportunities for teaching and research in a variety of fields, among them marine and environmental sciences, humanities, education and business. UNCW is a young institution, founded in 1947 as Wilmington college with 250 students and in 1971, by the act of the General Assembly of North Carolina, it became an university in the UNC-system. The serene beauty of the campus is attributed to the unique Georgian architecture of the numerous brick-buildings that house the different academic departments. There are now 8000 students and 412 instructional and research faculty, more than 75 % holding doctoral degrees. Just ten minutes from the campus is the new marine facility at the Myrtle Grove campus, opposite Masonboro Island on the Atlantic coast. Please visit our website <http://www.uncwil.edu/catalogue/Univer.htm#UNCW> for detailed information about the university.

The department of Biological Sciences at UNCW serves several main functions, those of teaching, research and public service. Where possible we seek to focus on those biological phenomena that impact on the quality of life in our region and the nation. The department's 38 faculty members all hold terminal degrees and have collective expertise in a great many areas of modern biology. The department offers a Bachelor of Science degree in Biology, a Bachelor of Science degree in Marine Biology, and a Bachelor of Arts degree in Biology. Master of Science degrees in both Biology and Marine Biology are also part of the curriculum. The department is housed in the New Science Building (built in 1997) and also in Friday Hall. The department maintains a modern 2250 square foot greenhouse, vertebrate range and a herbarium. The department, in cooperation with the Center for Marine Science Research (CMSR) uses a modern research vessel *Cape Fear* for coastal marine research. You can learn more at <http://www.uncwil.edu/bio/aboutus.htm>.

TRAVEL TO AND WITHIN WILMINGTON

Automobile:

Wilmington is located in southeast North Carolina on the banks of the Cape Fear River. The city is easily accessed by I-40 East. If you drive along the coast from the south take Hwy 17 North and from the north take Hwy 17 South to reach Wilmington. I-95 also intersects with I-40, not too far from Wilmington.

Air Travel:

Wilmington International Air Port is located at the edge of the city and is served by Delta Airlines, US Airways, American Airlines *etc.* US Airways is designated as the Official Airlines of this conference. However, you can make your own arrangement that suits you better. Allen Travel in Wilmington (1-800-849-6500) can handle your airline reservations and ticketing at discounted prices. Ask for Vic or Birgit Allen (910-395-6500 or fax 910-392-5841).

ACCOMMODATIONS

The Hilton will serve as the Primary Hotel for this conference. A block of rooms is available for \$105.00 per room (four persons maximum per room). Conference participants should make reservations directly with the Hilton (910-763-5900 or fax 910-343-0774). The Costal Line Inn, adjacent to the Coastline Convention Center and Hilton is also booked for the ASB meeting and is holding a block of 50 guest rooms at a rate of \$70.00 per room. Make reservations in advance by calling 1-800-255-6290 or 910-763-6739 or 763-2800).

Other accommodations include the following hotels:

<i>Within walking Distance</i>
Azalea Inn - 910-763-0121. Chandler's Wharf Inn - 910-815-3510
<i>For those participants who have a car</i>
Holiday Inn (Market Street) - 910-799-1440
Howard Johnson (Market Street) - 910-392-1101
Ramada Inn (Market Street) - 910-799-1730
Ramada Inn (Market Street) - 910-799-1730
Sleep Inn - 1-800-733-7466
<i>Wrightsville Beach (15 minutes drive to Hilton)</i>
Blockade Runner - 1-800-541-1161
Holiday Inn Sunspree Resort - 910-256-2231

PREREGISTRATION AND REGISTRATION

A pre-registration form is provided with this copy of the *ASB Bulletin*.

*The deadline for receiving pre-registration materials is **March 15, 1999**.*

Pre-registration is essential to ensure the most effective planning for social events, meals and field trips. Pre-registration packets will be available at the conference registration desk in the lobby of the Hilton on Wednesday April 14, 1999 from noon to 5:00 PM and Thursday, April 15, 1999 from 8:00 AM to 5:00 PM and Friday from 8:00 AM to noon. Late registrations will be held at the same location/times. Fees are not refundable after March 15, 1999. For pre-registration or cancellation of registration contact Ms. Nancy Meready at 910-962-3546.

PROGRAM INFORMATION

Please bring the April 1999 *ASB Bulletin* containing the detailed program and abstracts to the meeting. Copies will be sold at the registration desk during the meeting for \$5.00. Detailed program information including the schedule of talks, posters and titles of presentations in the symposia and workshops, along with descriptions of the proposed field trips, will be also available on the WorldWideWeb:

<http://www.uncwil.edu/bio/asb/asbprog.htm>

Please check this website frequently for the latest meeting updates

WEDNESDAY EVENING SOCIAL

We plan to hold a social with cash bar and snacks between 8:30 and 10:00 P.M. at the swimming pool area of the Hilton along the edge of the Cape Fear River. Music will be provided by a guitarist and a violinist from the UNCW Music department. This social will precede the Keynote address by Professor Edward O. Wilson of Harvard University at 7:00 P.M. in the Hilton ball room.

THURSDAY EVENING "GALA" AT UNCW

The motto of this meeting, as defined by the "Kim Tolson Principle", is: "You are here in Wilmington for a short time but you are here for a jolly good time". In this spirit, we will hold a reception for all ASB participants between 6:30 and 9:00 PM at the Warwick Center-Ball Room in the University of North Carolina at Wilmington. On the menu will be the typical Tar-Heel "Pig-Picking" with lots of other goodies as refreshments. Of course there will be plenty of liquid to quench your thirst: Wine, beer, Coke and Pepsi. Adjacent to the University Ball Room is the Center Cafe where live music will be provided with a local band. Shuttle service between the Hilton and the university campus will begin at 5.45 PM. No private vehicles will be necessary for this event.

FRIDAY EVENING ASB BANQUET

The ASB Banquet will be held from 6:30 - 8:30 P.M. at the Hilton Banquet Hall. The dinner will include both a vegetarian and non-vegetarian menu that will reflect our local specialties including shrimp, *Penaeus setiferus*. Immediately following the banquet, 8:30 - 10:00 P.M. or whatever (depending upon your stamina), will be a final social or farewell party featuring violin and guitar in the swimming pool area of the Hilton.

TENTATIVE GENERAL SCHEDULE

Wednesday, April 14

Registration Noon - 5:00 P.M.
 ASB Executive Committee meeting 2:00 - 6:00 P.M.
 SABS Council Meeting 3:00 - 7:00 P.M.
 ASB Social with cash bar and snacks 8:30 - 10:00 P.M.
 ASB General Plenary Session 7:00 -8:30 P.M.
 Announcements by Local Committee chair Dr. Robert Y. George
 Welcome by UNCW Chancellor James R. Leutze
 Remarks by ASB President Dr. Eloise Carter, Oxford College
 Award of "Sir George Deacon Medal" to Prof E. O. Wilson by
 North Carolina Chapter of the Fulbright Association

Plenary Lecture Dr. Edward O. Wilson, Harvard University
 "The Relation of Biology to Humanities"

Continuation of ASB Executive Board Meeting (if needed) 8:30 - 10:00 P.M.

Thursday, April 15

Past Presidents' Breakfast 7:00 - 8:00 A.M.
 Poster Set-Up 7:00 - 8:30 A.M.
 Registration 8:00 -5:00 P.M.
 Exhibits 8:00 -5:00 P.M.
 Workshop Sponsored By ASB Committee on Women,
 Minority and Disabled 10:00 -11:15 A.M.
 Workshop Sponsored By ASB Education Committee
 "Introductory Biology: Curriculum and Laboratory 10:30 A.M. - 1:00 P.M.
 Symposium sponsored by SABS
 "Southern Endemics, Zack Murrell, organizer 8:00 A.M. - 5:00 P.M.
 Paper and Poster sessions 8:00 A.M. - 5:30 P.M.
 SWS Luncheon Meeting 11:30 - 1.00 P.M.

Herbarium Curators' Meeting	4:00 - 6:00 P.M.
ASIH, SE Division Business Meeting	4:00 - 4:30 P.M.
SFC Business Meeting	4:30 - 5:30 P.M.
ASB Thursday Evening Social at UNCW	5.45 - 9:00 P.M.

Friday, April 16

SABS and BSA, SE Section Breakfast and Business Meeting	7:00 - 8:30 A.M.
Registration	8:00 - Noon
Exhibits	8:00 - 11:00 A.M.
Paper Sessions	8:00 - 5:00 P.M.
Symposium on "Coastal Ecology", Michael Durako and Robert Y. George, Organizers	8:30 -11:30 A.M.
Beta Beta Beta (BBB) Papers and Business Meeting	8:00 - 5:00 P.M.
ASB Business Meeting and Election of Officers	11:30 - 12:30 P.M.
Beta Beta Beta (BBB) Luncheon	11:30 - 12:30 P.M.
ESA, SE Chapter Luncheon and Business Meeting	12:30 - 1:30 P.M.
ASB Banquet and Awards	6:30 - 8:30 P.M.
ASB Social: Wind Down	8:30 -10:00 P.M.

Saturday, April 17

ASB Executive Committee Meeting	7:30 - 10:00 A.M.
ASB Field Trips:	
(1) Black River Canoe Trip	7:30 - 4:30 P.M.
(2) Fort Fisher and Zeke's Island	6:00 - 11:30 A.M.
(3) Green Swamp	8:00 - 2:00 P.M.
(4) Tidal Marshes and Swamps of the Cape Fear River	8:00 - 12:00 P.M.
(5) Bald Head Island	7:30 - 4:30 P.M.

**GUIDELINES FOR POSTER SESSION AND
ASB POSTER AWARD OF \$300**

Poster sessions have been incorporated as a regular means of scientific presentation at the annual ASB meetings. The ASB members, including graduate students as well as faculty, have an excellent opportunity to use the poster presentations in an informal atmosphere that encourages a direct exchange of ideas and discussion between presenter and audience. In order to stimulate greater use of posters as an effective means of presenting research results, ASB awards a \$300 cash prize to the best poster presentation. All posters will automatically be entered in a judging for the Poster Award.

Adherence to the following guidelines will help ensure the effectiveness of poster sessions.

- (a) Display should fit on a maximum size of 27 inches width and 38 inches height board suitable for mounting with "Sticky putty" (E.Z. TAK)
- (b) Posters must be displayed from 8:30 AM through 5:30 P.M. Thursday. Authors will

be required to be present near their posters at specified time during the annual meeting.

- (c) Posters must be carefully planned to maximize clarity and simplicity in conveying scientific information.
- (d) Posters should have a heading including a title, author(s), and their institution(s). This heading should be placed at the top in letters **no less than three cm high**.
- (e) The body of the poster including text, figure legends and table captions, should be no smaller than **18 pt. (3-4 mm)** and must be legible from a distance of one to two meters.
- (f) The body should be self-explanatory and should include figures, tables, graphs, maps or photographs displayed in a well organized and coherent sequence from top to bottom. Each illustration should include a caption. *Do not overcrowd the display*.
- (g) A limited degree of text can be included, but care should be taken not to overwhelm the audience.
- (h) A large, abbreviated version of the abstract should be presented at the top of the poster but below the heading. A clear listing of specific conclusions should appear at the bottom, preferably written either in bold letters or italics.
- (i) For the selection of ASB poster award, judges will take into account not only the adherence to the above listed guidelines, but also the following specific criteria:
 - (1) Overall aesthetics and attractiveness of the presentation.
 - (2) Ease of reading from a distance (1-2 meters).
 - (3) Clear and concise organization.
 - (4) Formulation of a clearly stated hypothesis
 - (5) Soundness of methods for testing the hypothesis
 - (6) How well conclusions are supported by results.

FIELD TRIPS

ON YOUR OWN: TRIPS OR TOURIST DESTINATIONS

1. *UNCW campus*: Enjoy a walk around the campus and visit the Randall Library in the center of the university. From the conference venue, take Market street and turn right on College road to go to the campus.
2. *Greenfield Lake*: Just 12 miles drive from The Hilton hotel. It is a beautiful lake with lots of flowering plants and a five-mile scenic drive around the lake.
3. Visit the *Orton Plantation*. Booklets will be available at the Registration desk.
4. Visit *En-Henwood Nature Preserve*. The walking trails include (a) Beechnut trail, (b) Black Gum trail (c) Blueberry trail (d) Dogwood trail (e) Holly loop (f) Laurel Oak trail (g) Lichen loop (h) Loblolly loop (i) Pine trail (j) South Prong trail (k) Sweet Gum trail (l) Stewartia trail (m) Town Creek trail (n) Tulip tree trail and (o) Turkey Cock trail. It should take one hour by car from The Hilton to reach Ev. Henwood and at least two to three hours to walk through all trails. This nature preserve, managed by UNCW, is 174 acres in Brunswick County, located at 6150 Rock Creek Road. Follow US 17, follow Old Town Creek Road to its intersection

with Town Creek Road, turn right and go three blocks to Rock Creek Road. For information call 910-962-3487. Botany Professor Dr. David Sieren of UNCW will guide selected walking tours.

5. *North Carolina Aquarium* at Fort Fisher: Booklets on the aquarium will be available at the registration desk.
6. *USS North Carolina Museum*. Located opposite of the Hilton across Cape Fear River, this marvelous museum is a great attraction for visitors to Wilmington

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Department of Biological Sciences
601 College Road, Wilmington, NC 28403
910-962-3470 fax: 910-962-4066

Meeting Headquarters Wilmington Hilton
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Wilmington, NC 28401
910-763-5900

Local Arrangements Coastline Convention Center
Committee Out-post Coastline Inn
501 Nutt Street,
Wilmington, NC 28401
910-763-6739

PROPOSED FIELD TRIPS FOR THE 1999 ASB MEETING IN WILMINGTON, NC

1. Black River Canoe Trip
Saturday, April 17, 7:30A.M. - 4:30 P.M.

The Black River is a coastal plain, blackwater stream that is almost undeveloped. Swamps along its banks harbor 2000 year old bald cypress trees. Most of these trees are found in dwarf swamp forests through which the river flows. Sand banks along parts of the river are home to burrow nesting swallows. Travel time to the entry point is approximately 1 hour. Leader: Dr. Martin Posey, UNCW. Fees include canoes, life preservers, lunch, and travel. Limit 25 :Cost \$53.

2. Fort Fisher and Zeke's Island

Saturday, April 17, 6:00 A.M.-11:30 A.M.

Shore birds of many species may be seen on the sand and mud flats near Ft. Fisher, a Civil War fortress. Colonial nesting birds including many species of egrets and ibises which nest and forage in this area. Brown pelicans, terns, osprey, and gulls complete the list of coastal birds likely to be seen. Bald eagles can also be observed. Zeke's Island is a part of the North Carolina Estuarine Reserve and contains an active inlet as well as many geological features characteristic of active inlets. The reserve includes vast expanses of salt marsh. Immediately adjacent is the Cape Fear River. Leaders Dr. James Parnell, UNCW and Dr. John Taggart, NCDWM. Limit 28: Cost \$8.

3. Green Swamp

Saturday, April 17, 8:00 A.M. - 2:00 P.M.

Located just south of the Cape Fear River is the Green Swamp. This large flat basin has been largely converted to pine plantations and farms, but substantial sections remain. The Nature Conservancy and state agencies are managing large sections with fire and converting both pine flatwoods and pocosin to its normal, fire tolerant savanna-like state dominated by longleaf pines. Carnivorous plants including the famous venus flytraps are common as are a variety of orchids, sedges, and grasses. Pond pine, pond cypress, and many evergreen hardwood shrubs may be found in pocosins within the Green Swamp. White Cedar stands are also developing within the reserve. This area is the best example of Pre-Columbian coastal plain habitat available today. Leader Ms. Linda Gintoli, Nature Conservancy. Limit 28: Cost \$15, includes box lunch.

4. Tidal Marshes and Swamps of the Cape Fear River

Saturday, April 17, 8:00 A.M. - Noon

The Cape Fear River contains the entire range of tidal habitats found along the mid-Atlantic coast including Tidal Swamps, oligohaline marshes, brackish marshes and salt marshes. Over 50 different vascular plants can be found along this gradient. In addition the Cape Fear River has experienced rapid sea level rise because of the deepening and widening of the river channel by the U.S. Army Corps of Engineers. Dead and dying forests will be observed at several of the sites visited. Leader Dr. Courtney Hackney, UNCW. Limit 28: Cost \$8.

5. Smith Island Complex (Bald Head Island)

Saturday, April 17, 7:30 AM-4:30 PM

This three island complex located at the mouth of the Cape Fear River contains one of the largest extant maritime forests along North Carolina's coast. It is accessible only by private ferry or boat. In addition to the maritime forest, these islands feature extensive dune systems, tidal marsh, freshwater marsh, and more than 6 miles of beaches. The island complex is the most northerly beach environment where loggerhead turtles nest in large numbers and represents the most northerly location for the cabbage palm (*Sabal palmetto*). The partially developed islands graphically illustrate the opportunities and problems of human development on coastal islands. Includes Lunch. Leader Dr. Paul E. Hosier, UNC-Wilmington. Limit 13: Cost \$50.

Registration Form: ASB - Association of Southeastern Biologists

Refunds/cancellations: Fees can only be refunded if a written notification of withdrawal is received three (3) university working days prior to the conference. Call (910)962-3195 to register by phone with your credit card.

60th Annual Meeting Hosted by The University of North Carolina at Wilmington, Wilmington, North Carolina April 14-17, 1999

PRE-REGISTRATION FORM

(Type or clearly print one form per registrant)

Name _____

☐ Faculty ☐ Graduate Student ☐ Undergraduate Student

Social Security No. _____ (required by IRS if you plan to file for tax credit.)

Institution _____

Mailing Address _____

City _____ State _____ Zip _____

Office Phone (____) _____

Email _____

The NC Public Records Act requires us to release you name and address if requested, unless you specify you not want the information released. Do you want this information released? ☐ Yes ☐ No

Affiliation (check where appropriate):

☐ ASB	☐ ASIH	☐ BBB	☐ BSA
☐ ESA	☐ SFC	☐ SABS	☐ SWS

Pre-Registration fee:

Regular: \$60.00* _____ \$ _____

Student: \$20.00* _____ \$ _____

*Wednesday Social Included

Late registration: Regular \$70.00; Student \$25.00

Wednesday Evening ASB Social: I plan to attend ☐

Regular: \$25.00 _____ x _____ tickets \$ _____

Student: \$20.00 x tickets \$

Regular: \$25.00 _____ x _____ tickets \$ _____

Student: \$20.00 _____ x _____ tickets \$ _____

Entree preference: # fish ____ # poultry ____ # vegetarian ____

ASB Past Presidents \$7.00 x _____ tickets _____ \$ _____

SABS/BSA \$12.00 x ____ tickets _____ \$

Beta Beta Beta \$10.00 x ____ tickets _____ \$ _____

ESA/SE Chapter \$10.00 x ____ tickets _____ \$ _____

SWS \$10.00 x _____ tickets _____ \$ _____

1. Black River Canoe Trip \$53.00 x ____ tickets \$ _____

2. Fort Fisher & Zeke's Island \$ 8.00 x tickets \$

3. Green Swamp \$15.00 x tickets \$

4. Tidal Marshes & Swamps \$ 8.00 x tickets \$

5. Smith Island Complex \$50.00 x tickets \$

Total Amount Enclosed \$

Provide the following

Mail this completed form, along with your check payable to UNCW, or credit card information to:

Mail pre-registration form and check to:

**Registration, Public Service and Extended Education,
UNC Wilmington, 601 South College Rd.
Wilmington, NC 28403-3297.**

DEMOGRAPHY REPORT

Patricia Cox, The University of Tennessee

The 1997 ASB Executive Committee requested a demographic study of the Association's members. The goal was to determine what types of institutions are represented and who actually attends the meetings. These data were accumulated from the 1997 membership list and the 1997 list of attendees at Furman University, Greenville, SC.

The The Association of Southeastern Biologists currently has members representing 220 academic and 59 non-academic institutions. Master's institutions contribute the largest membership at 40% followed by Ph.D. research institutions (24%), doctoral universities (13.5%), bachelor institutions (10%), and community colleges (3%). Nine percent of our members belong to non-academic organizations.

Member institutions are not evenly represented at the annual meetings. In 1997 31% of the attendees were from master's universities, followed by doctoral and Research institutions each with 13.9%, B.S./B.A colleges with 18.9%, and community colleges with 5%. Non-academic organizations represented 12.8% of the total attendees.

LIST OF MEMBER INSTITUTIONS BY CATEGORY

Numbers of members at the institution appear to the right of the name.

RESEARCH UNIVERSITIES

50 or more doctoral degrees

Auburn Univ. _____	5	Univ. of Arkansas _____	3
Clemson Univ. _____	13	Univ. of California at LA _____	1
Cornell Univ. _____	1	Univ. of Florida _____	5
Duke Univ. _____	1	Univ. of Georgia _____	9
Emory Univ. (includes Oxford Col.) _____	6	Univ. of Kentucky _____	3
Florida State Univ. _____	2	Univ. of Maryland _____	2
George Washington Univ. _____	1	Univ. of Nebraska _____	2
Georgia Institute of Technology _____	1	Univ. of North Carolina, Chapel Hill _____	10
Harvard Univ. _____	1	Univ. of South Carolina _____	7
Louisiana State Univ. BR _____	6	Univ. of South Florida _____	2
Michigan State Univ. _____	1	Univ. of Tennessee, Knoxville _____	15
Mississippi State Univ. _____	6	Univ. of Virginia _____	1
North Carolina State Univ. _____	12	Univ. of Wisconsin _____	1
Ohio State Univ. _____	1	Vanderbilt Univ. _____	1
Ohio Univ. _____	1	Virginia Polytechnical Institute _____	3
Southern Illinois Univ. _____	11		
Temple Univ. _____	1	Total members: _____	145
Tulane Univ. _____	7	Total institutions _____	34
Univ. of Alabama at Birmingham _____	3		

DOCTORAL UNIVERSITIES I: 40 Doctoral degrees in 5 or more disciplines

DOCTORAL UNIVERSITIES II: 10 Doctoral degrees in 3 or more disciplines
or 20 or more degrees in one or more disciplines.

Bryn Mawr Col. _____	1*	Howard Univ. _____	4
Delta State Univ. _____	1*	Indiana Univ. of Pennsylvania _____	1
Eastern Carolina Univ. _____	7	Louisiana Tech Univ. _____	1
East Tennessee State Univ. _____	8	Middle Tennessee State Univ. _____	2
George Mason Univ. _____	3	Northeast Louisiana Univ. _____	7
Hampton Univ. _____	2*	Old Dominion Univ. _____	7

St. John's Univ. _____	1	Univ. of Regina _____	1
Southern Univ. _____	1	Univ. of Southern Mississippi _____	4
Tennessee Technological Univ. _____	1	Univ. of Southwest Louisiana _____	2
Univ. of Alabama _____	7	Univ. of Tampa _____	1
Univ. of Central Florida _____	2	Wake Forest Univ. _____	1
Univ. of Cincinnati _____	1	West Virginia Univ. _____	1
Univ. of Guelph _____	1	Widener Univ. _____	1*
Univ. of Memphis _____	1		
Univ. of Mississippi _____	5	Total members: _____	76
Univ. of Missouri _____	1	Total institutions: _____	29
Univ. of Nebraska _____	1		
Univ. of New Orleans _____	1		

* Other type of doctoral Univ...not type I or II

MASTERS DEGREE I: 40 or more in 3 or more disciplines
MASTERS DEGREE II: 20 or more in 1 or more disciplines

Appalachian State Univ. _____	22	North Carolina A&T State Univ. _____	1
Auburn Univ. at Montgomery _____	1	Northern Kentucky Univ. _____	9
Austin Peay Univ. _____		North Georgia Col. and State Univ. _____	5
Belmont Univ. _____	3	Pembroke State Univ. _____	3
Berry Col. _____	3	Pfeiffer Univ. _____	1
Columbus State Univ. _____	6	Queens Col. _____	1
Christopher Newport Univ. _____	2	Radford Univ. _____	1
Col. of Charleston _____	1	Rollins Col. _____	1
Converse Col. _____	1	St. Peter's Col. _____	1
Cumberland Col. _____	1	Salem Col. _____	1
Eastern Carolina Univ. _____	7	Samford Univ. _____	1
Eastern Kentucky Univ. _____	9	Shawnee State Univ. _____	1
Fayetteville State Univ. _____	1	Smith Col. _____	1
Florida Southern Col. _____	1	Southeastern Louisiana Univ. _____	4
Frostburg State Univ. _____	2	Stetson Univ. _____	1
Francis Marion Univ. _____	6	Stockton State Col. _____	1
Furman Univ. _____	7	SUNY at Oswego _____	1
Gardner Webb Univ. _____	2	Tennessee Technological Univ. _____	4
Georgetown Col. _____	4	The Citadel _____	2
Georgia Col. and State Univ. _____	2	Troy State Univ. _____	1
Georgia Southern Univ. _____	2	Towson State Univ. _____	3
Georgia Southwest Univ. _____	2	Univ. of Montevallo _____	1
Jacksonville State Univ. _____	11	Univ. of North Alabama _____	4
James Madison Univ. _____	3	Univ. of North Carolina, Charlotte _____	9
Lander Univ. _____	1	Univ. of North Carolina, Wilmington _____	8
Longwood Col. _____	1	Univ. of Richmond _____	1
Louisiana State Univ. at Shreveport _____	1	Univ. of the South _____	3
Loyola Univ, New Orleans _____	2	Univ. of Southern Alabama _____	1
Lynchburg Col. _____	1	Univ. of Tennessee, Chattanooga _____	4
Marshall Univ. _____	15	Univ. of Tennessee, Martin _____	1
McNeese State Univ. _____	1	Valdosta State Univ. _____	3
Mary Washington Col. _____	1	Western Carolina Univ. _____	3
Meredith Col. _____	1	West Virginia Institute of Technology _____	1
Millersville Univ. _____	1	West Virginia Wesleyan Col. _____	1
Milligan Col. _____	1	Western Kentucky Univ. _____	8
Millsaps Col. _____	1	Whitworth Col. _____	1
Mississippi Univ. for Women _____	1	Wingate Univ. _____	3
Morehead State Univ. _____	2	Winthrop Univ. _____	4
Murray State Univ. _____	2		
North Adams State Col. _____	1	Total members: _____	227
		Total institutions: _____	76

BACCALAUREATE COLLEGES

Agnes Scott Col. _____	1	Kennesaw State Col. _____	1
Anderson Col. _____	1	Louisiana Col. _____	1
Armstrong Atlantic State Univ. _____	2	Mars Hill Col. _____	2
Barton Col. _____	2	Monmouth Col. _____	1
Berea Col. _____	2	Mt. Olive Col. _____	1
Brevard Col. _____	1	Newberry Col. _____	1
Bowie State Univ. _____	1	Peace Col. _____	2
Catawba Col. _____	3	Presbyterian Col. _____	1
Clafflin Col. _____	1	Randolf Macon Col. _____	2
Clayton State Col. _____	2	St. Andrew's Col. _____	1
Coastal Carolina Univ. _____	2	St. Augustine's Col. _____	1
Coker Col. _____	1	Shorter Col. _____	1
Eastern Mennonite Univ. _____	1	Southern Adventist Col. _____	1
Eckerd Col. _____	1	Southern Col. _____	1
Elon Col. _____	3	Tennessee Wesleyan Col. _____	1
Emory and Henry Col. _____	1	Thomas More Col. _____	1
Erskine Col. _____	4	Union Col. _____	1
Fairmont State Col. _____	1	Univ. of NC, Asheville _____	3
Ferrum Col. _____	1	Univ. of South Carolina, Aiken _____	1
Floyd Col. _____	1	Virginia Military Institute _____	1
Franklin Col. _____	1	Young Harris Col. _____	1
Georgia Col. and State Univ. _____	2		
Guilford Col. _____		Total members _____	65
High Point Univ. _____	1	Total institutions _____	45
Illinois Col. _____	2		

**ASSOCIATE OF ARTS COLLEGES AND
COMMUNITY COLLEGES**

Alabama Southern Comm. Col. _____	1	Louisiana State Univ. at Alexandria _____	1
Coastal Georgia Comm. Col. _____		Piedmont Virgin Comm. Col. _____	1
Columbia State Comm. Col. _____	1	Sandhills Comm. Col. _____	1
DeKalb Col. _____	4	Virginia Highlands Comm. Col. _____	1
D.S. Lancaster Comm. Col. _____	1	Western Piedmont Comm. Col. _____	1
Florence Darlington Col. _____	1		
Greenville Technical Col. _____	1	Total members _____	16
Lexington Comm. Col. _____	1	Total institutions _____	13

**OTHER (MUSEUMS, GOVERNMENT,
PRIVATE INDUSTRY)**

Field Museum _____	1	Alabama Dept of Environmental Mgt. _____	1
Milwaukee Museum _____	1	Carolina Biological Supply _____	1
National Museum of Natural History _____	1	Nature Conservancy _____	1
Virginia Museum of Natural History _____	1	Savannah River Ecology Lab _____	16
Academy of Natural Sci. Philadelphia _____	1	Grouse Marine Lab _____	1
Virginia Institute of Marine Sci. _____	1	USDA Southern Weed Lab _____	1
Georgia Dept. of Natural Resources _____	1	Brunch Forest Sci. Inst. _____	1
Tennessee Aquarium _____	1	Johnson Marine Education Center _____	1
Florida Dept. of EPA (Aquatic plants) _____	1	Dauphin Island Sea Lab _____	1
Hester Industries _____	1	USES _____	7
Breedlove, Dennis and Assoc _____	1	USDA, Forest Service _____	4
Geraghty and Miller Inc. _____	1	USDA _____	1
Enlivens Inc. _____	1	Florida Caribbean Sci. Center _____	1

Tall Timbers Res. Station _____	2	Wildlife Supply _____	1
Lockheed Martin _____	1	South Carolina Natural Heritage _____	1
Kennedy Space Center _____	2	Discovery Place _____	1
ORNL _____	2	North Carolina Division of Marine Fishes _____	1
Gulf Coast Res. lab _____	1	Dept. of Nat. Resources of Kentucky _____	1
US Army Corp of Engineers _____	1	Martin Institute _____	1
J Jones Ecological Res. Station _____	2	HDR Engineering _____	1
Center for Wetlands _____	2	Baltimore Gas and Electric _____	1
Archibold Biological Station _____	1	School of Forest Res. _____	1
Alabama Geological Survey _____	1	Outdoor Ventures _____	1
National Estuarine Res. _____	1	3d Environmental _____	1
EPA _____	1		
TVA _____	1	Total members _____	59
Georgia Natural Heritage _____	1	Total institutions _____	31

SO, YOU WANT TO HOST AN ASB MEETING ---?

J. Kenneth Shull, Jr.
Appalachian State University

Many universities may want to host an ASB meeting but do not know if there are adequate facilities at their institution and/or in their community. How many participants should you expect, how many meeting rooms are needed, *etc.* When the Biology Department at Appalachian State University was thinking of hosting the ASB meeting we did not know what was required to host such a convention, even though all of us had been to professional meetings. John Herr had written *The ASB Meeting - 1986: University of South Carolina, Columbia*, which is a guide of what you should do after ASB has accepted an invitation from an institution, and our conversations with him proved most helpful. We made a study of our convention facilities, the availability of hotel and motel rooms, *etc.* and decided that we could, indeed, host an annual meeting of ASB. I was the chair of the Local Arrangements Committee and I promised John that I would write a summary of what we had learned to compliment his book. This is that long-promised summary which is written with the help of Howard Neufeld, the program chair of the Boone meeting.

Time of the Meeting

ASB meetings are held in the Spring, usually in early April, but not the week before Easter Sunday, nor the third week in April when the Appalachian Wildflower Pilgrimage is held. The first events occur on Wednesday afternoon and Wednesday evening. The Plenary Session is held on Wednesday evening or Thursday morning, while the paper sessions are on Thursday and Friday morning and afternoon. Most of the field trips are on Saturday morning. You should invite ASB at least two years before you plan to host the meeting.

Events

An ASB meeting is really several meetings in one. Events to be planned include the paper sessions, the Wednesday night mixer, Thursday night social event, the Friday night banquet, business meetings of various societies that meet with ASB, various breakfast meetings, field trips, the ASB business meeting, the Wednesday afternoon and Saturday morning meetings of the ASB Executive Committee and the paper sessions, teaching workshop on Friday, general meeting and special events

of Beta Beta Beta. The societies that meet with ASB will vary from year to year, but five or six such societies would be about average. The American Society of Ichthyologists and Herpetologists (Southeastern Division) does not meet with ASB in years when their national meeting is in the Southeast. The Southeastern Society of Parasitologists meets with ASB on odd-numbered years.

Facilities

The convention facilities should handle a meeting of about 750 participants. Most ASB meetings are not that large but can range in size from 450 to 750. Since the size of any meeting cannot be predicted, plan for the maximum. The number of affiliated societies meeting with ASB on a given year will partially determine the number of people who attend. You should plan on seven concurrent paper sessions at any one time. Each room should seat a minimum of 60 people in theater style and two or three rooms should seat 75 - 125. Some symposia draw 150 to 200 people and need a banquet hall or theater. In recent years some symposia and special interest sessions have been held on Wednesday evening. There is usually a Wednesday evening mixer with a cash bar. One small room is needed for presenters to review slides, and another for informal meetings or interviews for jobs. The ASB business meeting on Friday at 11:00 AM will have about 150 attendees. It must be possible to light-proof the rooms for slide presentations. Do not take the word of the convention center that it is possible -- check for yourself. Convention center personnel often do not understand the importance of a completely dark room.

Various societies will hold breakfast or luncheon meetings on Thursday and Friday. If these meetings must be held in the rooms where the paper sessions take place then about an hour is needed to set up and thirty minutes to break down the room for a meal. If too many meeting rooms are used in this way there will be some problems in scheduling paper sessions. If the noon meal takes too long it becomes a problem for the participants to get back in time for afternoon meetings, so it is necessary for restaurants to be nearby. Although you should probably allow two hours for lunch, some recent meetings have allowed only one and one-half hours.

The convention center should have projectors and screens to accommodate all concurrent sessions as well as slide review sessions. If these are not available at the center, your own AV department should be able to supply them. Do not forget extension cords and multiple receptacles for the paper sessions and the commercial exhibitors. Some presenters will need overhead projectors and/or VCRs and monitors.

Commercial exhibitors need a large space that can be locked at night since many exhibitors will have very expensive equipment in their spaces. If the exhibitor space cannot be locked you will need to be able to provide security in some other way. Although there are usually only about 20 exhibitors, you need to plan for 30, each with an 8' X 12' booth and about 6' aisles between rows of booths. A rectangular room would need to be about 72' X 84', but each floor plan will differ, so it is wise to draw off the plan of your room and draw in the booths and aisles to make sure you have enough space. Plan for about 12-15 booths with electricity. If your convention center does not provide pipes and drapes for the exhibitors, be sure you can find a company who does. For the Boone meeting we had to hire a company out of Charlotte, NC, about 100 miles away, and they were very expensive. The commercial exhibitors' fees often provide for any money returned to ASB, and the

society heavily depends on this source of income, so you must plan carefully for them. They need to be near the center of the activities, in the same room with, or immediately beside the morning and afternoon breaks, close to the registration desk, if possible, and should not be placed in a basement or in a separate building. Commercial exhibitors will set up on Wednesday afternoon and evening and will break down Friday about 12:00 Noon.

Until recently it was the custom to hold the meetings on campus, either at a student union building or in the biology or science building. We find that ASB members really do like to meet on the campus or at least have an opportunity to tour the college. Campus convention centers are acceptable, but if no place on campus is available, the meeting can be held at a local hotel or convention center. If that is where the meeting must be held, try to plan the Wednesday or Thursday evening events on the campus.

Housing

To accommodate 750 participants the community needs to have about 500 hotel/motel rooms within a 15 minute drive, or about one room for each 1.5 participants. Your chamber of commerce or tourist information center can provide a good count. If you notify the hotels and motels in time you can usually get discounts for participants. If the convention center has motel rooms, you can ask for two or three complimentary rooms for the featured speaker, president, president-elect, etc.

Thursday Night Social and Friday Night Banquet

For a 750 member meeting you can expect to have up to 500 participants at the Thursday night social, depending on the entertainment. A Friday night banquet of 250 would be a large banquet. This is considered to be a highlight of the meetings and should be carefully planned.

The Local Arrangements Committee

Before you invite ASB to meet on your campus be certain that your faculty will agree to play a major part in the plans and the meeting. The chairs of the Local Arrangements Committee and the Program Committee should have some release time, especially in the Fall semester. These will be busiest from the last week in November through the first week in December and again the two weeks before the meeting itself. Even if your convention center or office of conferences assures you that they do not need any help, appoint faculty to chair AV, social, transportation, registration, entertainment, housing and commercial exhibitor committees. These people will help you spot any problems and can act as liaison between the participants and the convention center staff. The Commercial Exhibitors Committee is an extremely important committee, and you should be certain you have very active people to agree to serve. It takes special people to plan a good Thursday evening social, so the Social Committee should be chosen carefully. The chairs of all committees should be tentatively set by the time you invite ASB. You will need to consult with your administration and have them send a formal invitation to the current president of ASB.

Transportation

If the convention center is not near convenient parking and public transportation you might consider using shuttle busses to and from the major hotels. If the Thursday night social is not at the center you will need to provide transportation to

and from the event, especially if alcohol will be served. The same is true of the Friday night banquet. Very few participants fly to the meeting, but you do need to provide shuttle service to the airport if requested.

Field Trips

Every place in the Southeast has something around it that biologists find interesting. Ask the field biologists on your faculty for ideas for outdoor activities. Many local industries have interesting tours as was demonstrated in Baltimore. National and state parks, science museums, public gardens, etc. offer a good variety of trips. Good guides are important and your faculty and graduate students are an excellent source of such talent. We offered a shopping/sightseeing tour for spouses and friends of participants on Friday morning at the Boone meeting and the turn-out was very good.

Costs

The ASB meetings have traditionally been relatively inexpensive and it is the desire of the association to continue that tradition. Check with your convention center about costs, but if the center is in conjunction with a hotel and you reserve rooms for participants you will probably have no charge for meeting rooms. In Boone we used our office of Conferences and Institutes to handle many of the local arrangements and their help was invaluable. Such offices can assist you in calculating the registration fee, plan break snacks, luncheons, the banquet, help arrange for AV services, etc. Our office cost us \$6.00 per registrant per day, or \$18 per person. That cost, obviously, must be included in the registration fee.

To summarize, the following facilities are needed to host an ASB meeting:

Meeting rooms for

concurrent sessions: 5 to seat 60 people, 2 to seat 75-125.

Meeting rooms for symposia: 2 to seat 150-200.

Other rooms: 2 or 3 small rooms for slide previews and interviews.

Banquet facility: To seat 250.

Breakfast and luncheon rooms: 3 to seat 25 at breakfast, 2 to seat 100 at lunch.

Commercial exhibitor space: A secure room to place 30 8 X 12 foot exhibit spaces, 12 - 15 with electricity.

Thursday evening social: Plan for 500.

Hotel/motel rooms: 500 in the community.

Adequate parking and/or public transportation.

Hosting an ASB meeting is a lot of work, but there is help available in John Herr's *The ASB Meeting - 1986: University of South Carolina, Columbia*, as well as from former chairs of Local Arrangements Committees and Program Committees. The benefits of the effort are great. By hosting ASB you will get the name of your institution before the biologists of the Southeast and advertise any of your special programs or facilities, you may attract graduate students to your program (we did) and the turn-out will likely impress your administration. There is a more important benefit. By hosting ASB you will be contributing to the organization and to the exchange of ideas among biologists in the Southeast.

OBITUARIES**DR. DAVID J. COTTER**

1932-1998

Dr. David J. Cotter, Professor Emeritus at Georgia College and State University, was born on July 24, 1932 in Glen Falls, NY and died on July 11, 1998 at the age of 65 in Milledgeville, Ga.

David was a distinguished faculty member, scholar, and outstanding teacher throughout his professional career. He earned his B.S. Degree in Biology in 1952, his B.A. Degree in History in 1953, and his M.S. Degree in Biology in 1955, all from the University of Alabama. In 1958, he acquired his Ph.D. in Biology from Emory University in Atlanta. In 1963, post-doctoral work as a Research Associate was completed at Emory University. From 1966 to 1968, additional post-doctoral studies were performed at the University of Georgia and Savannah River Ecology Laboratory. From 1958 to 1966, Dr. Cotter was an Assistant, then Associate Professor of Biology at Alabama College where he also directed the N.S.F. Summer Science Institute. From 1966 to 1994, he served ably as both full Professor and Chairman of the Department of Biological and Environmental Sciences at Georgia College. In the summer of 1969 and winter of 1970, he was the Staff Biologist, Office of Biological Education, AIBS Headquarters, in Washington, D.C.

His professional publications were numerous and varied, ranging from studies on the ecological life history of *Portulaca smallii* to the effects of radioactivity on the Southeast Granite Outcrops to an analysis of stem-leaf relationships of twenty-one tree species at the Savannah River Plant. Furthermore, he was successful in obtaining over \$500,000 in grant awards from the AEC, NSA, and AIBS agencies, awards that furthered not only personal research but also enriched the many facets of the Biology curriculum at both the college and secondary school levels. Dr. Cotter's invaluable contributions to the learning of the Biological Sciences were reflected by his writing over 100,000 test items and some fifty study guides/instructor's manuals (involving over 20 different publishers) which accompanied many of the major textbooks in the discipline.

Dr. Cotter received significant awards, honors, and citations throughout his career. In 1970, he was named Distinguished Professor by the Georgia College Foundation. In 1973, he was President of the Association of Southeastern Biologists (he also served as Treasurer, Vice-President, and on the Executive Committee for the Association). From 1978 to 1984, he served on the Steering Committee for SOTAB (Symposium: State of the Art in Biology), a University System committee for the Faculty Development of Biologists in Georgia. In addition, he was an NSF panelist on ten separate occasions, judging a variety of grant applications. Other important accomplishments included serving as a participant in the N.S.F. Chautauqua Course at Clark College in Atlanta, being a charter member of the Georgia Climatological Society, and working on high school accreditation teams in 1979 and 1984. Dr. Cotter's honorary associations were Beta Beta Beta, Phi Sigma,

Sigma Xi, Phi Kappa Phi, and Who's Who. Finally, Dr. Cotter was an active participant in community affairs, receiving the Arts Service Award from the Milledgeville-Baldwin County Recreation Parks and Allied Arts Commission and serving on the Board of Trustees for the Community Concert series, Milledgeville Arts Alliance, and the Oconee Cultural Alliance.

Dr. Cotter was an invaluable asset to the profession and to the college institutions at which he taught. In particular, he was an academic pioneer who played an invaluable role in the building of Georgia College's reputation. He was blessed with a great sense of humor, unwavering integrity, and consummate kindness toward his colleagues and students. All of his friends will miss him very much. He is survived by his wife, Joann, three sons — Barry, Mark, and Walter, and five grandchildren.

DR. WILLIAM S. WOOLCOTT

1922-1998

Dr. William Starnold Woolcott, D.A. Kuyk professor emeritus at the University of Richmond and long time active member of the Association of Southeastern Biologists, died 18 April 1998. He was 76. Born 14 April 1922 in Coffeyville, Kansas, Bill led a distinguished and productive teaching and research career. A 1947 graduate of Austin Peay State University, he earned a Master's from George Peabody College, now part of Vanderbilt University. He taught biology for four years at Carson-Newman College in Jefferson City, Tennessee and then earned a Doctorate in vertebrate zoology under Dr. Edward C. Raney from Cornell University in 1955.

Dr. Woolcott, whose many students often presented papers at our Annual Meetings, joined the University of Richmond's Department of Biology in 1955 and was appointed to the Kuyk professorship in 1980, a position he held until his retirement in 1992 when his 35+ graduate students hosted a party to honor his retirement and leadership as a mentor, friend, and colleague. An ichthyologist and vertebrate zoologist, Bill was curator of the university's research fish collection. In addition, he coordinated the graduate program in biology and was a former chair of the faculty research committee. In his 37 years at University of Richmond, he conducted research with scores of undergraduate students and over 35 graduate students. He authored more than 60 scientific papers, and was awarded the Distinguished Educator Award, University of Richmond's highest honor for faculty members. His research continued even after retirement, when with Dr. Eugene Maurakis he co-produced a videotape, *Phylogenetic Systematics*, which is used as an educational tool in a number of museums and universities throughout the world. He was a member of numerous professional societies including the Society of American Zoologists, American Society of Ichthyologists and Herpetologists, and the Virginia Academy of Science.

Dr. Woolcott, a member of River Road Baptist Church, was also a former board member of the Maymount Foundation in Richmond and the Virginia Nature Conservancy League. He is survived by his wife, Betty Gilbert Woolcott, and two daughters, Neil W. Powell, and Catherine W. Edwards.

REVIEWS

Dr. Frank Schwartz, Review Editor
Institute of Marine Science, 3431 Arendell St.
University of North Carolina, Morehead City, NC 28557

Gotelli, N.J. 1998. **A Primer of Ecology**. Sinauer Associates, Inc., NY. \$23.95. 236 p.

This is a well-written, nicely-organized introduction to population modeling! It brings up-to-date the 1971 volume *A Primer of Population Biology*, by E.O. Wilson and W.H. Bossert. As the author indicates: "this primer is not a substitute for a full-length ecology text". However, it provides a very nice development of population models both for the advanced undergraduate and graduate student who may be new to modeling. In each chapter, models are developed from first principles, model predictions are given, model assumptions are described, one or more model variations are described, and finally one or more empirical examples are presented.

The first chapter presents Malthusian or simple exponential growth. Chapter 2 then presents the extension to density dependent growth, and, in particular, that of the logistic growth model. Age-structured population growth is presented in Chapter 3, including discussion of life tables, the Leslie matrix, and stage-based extensions of Lefkovich. So-called metapopulation modeling is described in Chapter 4, where probability of regional extinction is examined in the light of extinction of local populations linked by migration. Two-species competition models developed by Lotka-Volterra (and extensions) are described using state-space graphs in Chapter 5, while predator-prey models are similarly described in Chapter 6. Model variations in Chapter 6 include consideration of predator functional response through modeling of searching and handling time. Island biogeography is the topic of Chapter 7. A useful appendix expands on how population models are constructed. Problems are given at the end of each chapter, with the solutions at the back of the book. A glossary, references cited, and index fill out this book.

I found this book highly readable and very engaging (I read through the first 5 chapters while flying from Tampa to Charlotte). The design of the book allows the reader to get a good feeling of the thought processes that modelers use to extend and/or expand models to better represent the population(s) with which they are working. Needless to say, I highly recommend this book.

Douglas S. Vaughan, *National Marine Fisheries Service, Beaufort, NC 28516.*

Brown, James H. and Mark V. Lomolino. 1998. **Biogeography** (Second Edition) Sinauer Associates, Inc. Publishers, Sunderland, MA \$64.95 (hard bound) 691 p.

The first edition of *Biogeography* by James H. Brown and Arthur C. Gibson was published in 1983. As the authors of the second edition state in their preface, "Biogeography has grown and changed rapidly in the last 20 years." I am in total

agreement. For those of you whom have waited for an updated edition of *Biogeography*, this second edition is certainly no disappointment.

Biogeography is a subject area that has been dealt with by a number of authors in the past. Some texts are far too brief, some are far too technical and better used as reference works than as classroom texts. I have used James Brown and Arthur Gibson's text for a number of years in a senior-graduate course with considerable success. In fact, it was the only text that seemed satisfactory for the objectives that I had established for the course.

In the updated version, Unit 1 contains two chapters one dealing with the science of biogeography and the other discussing the history of biogeography. This is a much improved introduction to the discipline, when compared with the original edition. Unit 2, *The Environmental and Historical Setting* might have been a bit improved if the authors had used a unit heading such as *The Environmental and Distributional Setting*. I would have placed Chapter 6 and 7 within the format of Unit 3, because *The Changing Earth* (Chapter 6) and *Glaciation and Biogeographic Dynamics of the Pleistocene* (Chapter 7) would better be placed in a section dealing with *Historical Patterns and Processes* (Unit 3).

Biogeographical areas that have always been of special interest to me include speciation, extinction (Chapter 8) and island biogeography (Chapters 13 and 14). The final portion of the text (Unit 5) includes information on continental patterns, the status of biodiversity and the advances that we may expect to see as we enter the twenty-first century. But most interesting of all (to me) was the inclusion of the biogeography of man (Chapter 18, *The Biogeography of Humanity*).

In summary, I would say that *Biogeography* gives us a very balanced approach to the entire discipline. I am not aware of any text that could be used within the classroom that would approach the detail and breadth of coverage accorded to the study of biogeography. In fact, the bibliography is 36 pages in length and covers the literature (unless I missed a citation) from 1820 to 1997!

CLIFF KNIGHT, *Department of Biology, East Carolina University, Greenville, NC 27858*

NEWS OF BIOLOGY IN THE SOUTHEAST

Jon R. Fortman-News Editor
Division of Science and Math
Mississippi University for Women
Columbus, MS 39701

ABOUT PEOPLE AND PLACES

MISSISSIPPI

University of Mississippi, Department of Biology. *Dr. Gary L. Miller*, Professor of biology, was named chair of the department. Dr. Miller served for several years as Acting Chair. *Dr. Stephen Secor* (Ph.D. UCLA) will join the faculty in January as Assistant Professor of biology. Dr. Secor is an ecophysiologicalist interested in the digestive physiology of snakes. He will teach general physiology and graduate courses in his field. *Dr. Lucile McCook*, Acting Assistant Professor of Biology, has been named Interim Curator of the **Thomas M. Pullen Herbarium**. Dr. McCook holds the Doctorate in systematic Botany from Cornell University. *Dr. Gail Stratton* (Ph.D., Univ. of Cincinnati) joined the faculty this year as Director of the Freshman Laboratory Program and Instructor. Dr. Stratton is a behavioral ecologist and continues her research on sexual isolation in wolf spiders. The Department established the **Dr. James P. Walker Freshman Computer Laboratory**. The facility was made possible by a generous gift from Dr. Walker's daughter, *Ms. Ygondine Walker Sturdivant*.

Mississippi State University, Department of Biological Sciences. Two new Assistant Professors joined the department this fall. *Dr. George Pinchuk* is an immunologist whose experience includes the Ph.D. degree from the Institute of Medical Genetics, Academy of Medical Sciences of the USSR, Moscow, Russia, and post-doctoral research at University of Southern California School of Medicine, Los Angeles, and the Fred Hutchinson Cancer Research Center in Seattle, WA. *Dr. John Welborn* is an animal physiology whose interests include the function of renal tubules. He received the Ph.D. from the University of Southern California, Los Angeles, and was a post-doctoral fellow at the University of Arizona, Tucson. *Dr. Michael Sullivan* is serving as Editor of the international journal, *Diatom Research*. *Dr. Armando A. de la Cruz* won the Alumni Foundation Upper Level Teaching Award. As recipient of this award, he served as the Mace Bearer at Commencement exercises in May. He also serves of the review panel of the U.S. Environmental Protection Agency office of Research and Development. *Dr. Karen St. Cyr-Coats* served as administrative intern in the Office of the Provost at MSU. She also presented the Annual Sigma Xi Lecture. *Dr. Giselle Thibaudeau* participated in the NSF Teacher Enhancement Program. *Dr. Dwayne Wise* was asked to serve as an international reviewer by the Ministry of Research to the Italian Government. *Dr. Lewis Brown* was named a proctor for the American College of Microbiology Examination. *Dr. Donald Downer* was named president-elect of the South Central Branch for the American Society for Microbiology. *Dr. Evan Weiher* attended the

IGBP-GCTE (International Geosphere-Biosphere Program-Global change & Terrestrial Ecosystems Workshop on Plant Functional Types and Responses to Disturbance), Montpellier, France in March 1998, as an invited lecturer. *Dr. Christopher Taylor* was selected for the program coordinating team of the Mississippi/Alabama Sea Grant Consortium.

KENTUCKY

Western Kentucky University, Department of Biology. *John Andersland*, (Ph.D., Cornell University) has joined the department as Electron Microscopy Technician. Dr. Andersland's professional background is in botany/plant cell biology, and he came to Western following a post-doctoral appointment at the Southern Regional Research Center, ARS-USDA, in New Orleans, La.

Morehead State University, Department of Biological and Environmental Sciences. *Dr. Carol Wymer*, (Ph.D., Penn State University) is a new faculty member in the area of plant physiology, and *Dr. Darrin DeMoss*, (Ph.D., **Marshall University**) filled the human physiology position. *Dr. David Magrane* was named as the University Outstanding Teacher for 1997-98 becoming the sixth department member so honored since the inception of the awards in 1965.

MUSEUMS AND BOTANICAL GARDENS

ALABAMA

Anniston Museum of Natural History, Anniston. During November 14 through December 24, 1998, the museum exhibited lithographs of George Catlin and the aquatint engravings of Karl Bodmer titled "Naturalists in the New West: Selections From the A.G. Edwards Corporate Collection." The "Garden Lecture Series" for February, March and April, 1999 will have noted horticulturists and garden experts from throughout the South giving talks on a variety of botanical subjects. During September 1998, the Museum had an exhibition called "Mysterious Manatees".

FLORIDA

Florida Caribbean Science Center, Biological Resources Division, Gainesville, Florida. A new book "Aquatic Fauna in Peril: A southeastern Perspective" looks at the changes and current status of the ecosystems and aquatic fauna of the Southeastern United States. This book was a collaborative effort by experts of the U.S. Geological Survey on southeastern ecosystems and faunal decline. Detailed descriptions of the environmental changes the Southeast has undergone in the past 200 years and the affects on the aquatic ecosystems is given in the book. To purchase the hardbound volume of "Aquatic Fauna in Peril" contact the Tennessee Aquarium at 423-785-4199 or 1-800-262-0695 ext. 4199.

Marie Selby Botanical Gardens, Sarasota. The JASON Project is celebrating its tenth anniversary with a comparative study of temperate, tropical, and fossil rain forests.

Science teachers and students from across the nation will join *Dr. Robert Ballard*, discoverer of the RMS Titanic, and his team of distinguished scientists for "Rainforests: A Wet & Wild Adventure." *Dr. Meg Lowman*, Director of Research and Conversation at Marie Selby Gardens will be the chief scientist in charge of the Rain Forest portions of this year's project at ACEER in Peru and Olympic National Park in Washington. A major grant of \$250,000 from NSF will enable scientists Dr. Lowman and *Dr. Joe Connell* of the University of California, and *Dr. Ian Noble* of Australian National University to continue long-term rain forest regeneration studies begun in Australia in 1963. The scientists hope to continue the project over the next two decades. For more information about the rain forest studies, contact Dr. Lowman at lowman@virtu.sar.usf.edu.

MISSISSIPPI

Mississippi Museum of Natural Science, Jackson. *Dr. Todd Slack* has joined the research staff at the Museum as a Wildlife/Fisheries Biologist. Dr. Slack is responsible for curating the state ichthyological collection in addition to conducting research on the ecology, conservation and management of nongame fishes and their communities within the state. Todd earned his Ph.D. from the University of Southern Mississippi. His current research includes studies on the larval ecology of the bayou darter and the movement and habitat use of gulf sturgeon in the Pascagoula River drainage.

ASB MEMBERSHIP DUES STRUCTURE

Please complete the information below, enclose check or money order payable to **Association of Southeastern Biologists**, and mail to **Gerhard Kalmus, Department of Biology, East Carolina University, Greenville, NC 27858-4353**. The mailing label shows the year through which you are paid -- for example, if the date is 1998, you need to pay for 1998 and 1999. Please contact Gerhard Kalmus; kalmusg@mail.ecu.edu (252)328-6306 if there is an error. Thank you for your support.

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_____ Total Enclosed: Paid for 1999 ____; 2000 ____; 2001 ____



THE *ASB BULLETIN*
VOLUME 46, NUMBER 1, JANUARY, 1999

In This Issue

NEW LOGO	1
60 TH ANNUAL MEETING	2
HOSTING AN ASB MEETING	17
OBITUARIES	21
DR. DAVID J. COTTER	21
DR. WILLIAM S. WOOLCOTT	22
REVIEWS	23
NEWS OF BIOLOGY IN THE SOUTHEAST	25

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The ASB BULLETIN

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April, 1999



The University of North Carolina at Wilmington
Host of the 60th ASB Annual Meeting

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PURPOSE

The purpose of this association shall be to promote the advancement of biology as a science by encouraging research the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. Members receive the *ASB Bulletin*.

TIME AND PLACE OF FUTURE MEETINGS

1999 April 14-17

University of North Carolina at Wilmington, Wilmington, NC

2000 April 5-8

University of Tennessee at Chattanooga, Chattanooga, TN

THE VIEW FROM HERE

Eloise Carter, President

For many biologists in the Southeast, including myself, the first publication of an abstract of our research was published in *The ASB Bulletin*. *The ASB Bulletin* has functioned as an important record of research efforts, book reviews, news, activities, and issues important to southeastern biologists. During the last several years the Executive Committee with leadership from members of the Publications Committee and Ken Shull, has discussed appropriate ways that the *Bulletin* might change to reflect the needs of biologists and to maintain its special identity. In December 1998 the ASB Bulletin published Issues in Biology, a new feature reflecting topics of interest to biologists. I congratulate Ken Shull and the ASB members who contributed to this excellent issue. I hope that many of you will continue to discuss these topics at Wilmington in April, and make note of issues you would like to contribute to the 1999 Issues in Biology.

Recently Ken Shull announced that he will retire as editor of the *ASB Bulletin* with the publication of the April issue of the year 2000. On behalf of the Executive Committee and the ASB membership I extend deep appreciation to Ken for his commitment to excellence, patient encouragement of authors, thoughtful reminders for new presidents, and tireless efforts to make every aspect of the publication of the *ASB Bulletin* more streamlined, efficient and cost effective. Ken's most significant contribution has been his knowledge and understanding of the nature of ASB, its members, and the organization, which have informed and directed his vision for the Association of Southeastern Biologists and the *ASB Bulletin*. During the ASB meeting in April, please take the time to thank Ken for his many contributions and to discuss any candidate who would be a willing and capable editor as the *ASB Bulletin* enters the next century.

The Association of Southeastern Biologists is honored to welcome Dr. E.O. Wilson to its 60th Meeting in Wilmington, North Carolina. Dr. Wilson can certainly be considered a southeastern biologist, whose early life and education began in Alabama. He is well-known for his work on biodiversity, but I am looking forward to hearing about the search for the unity of knowledge, consilience. Please encourage your colleagues and students to join us in Wilmington for this singular opportunity to hear Dr. Wilson's plenary address and to begin a discussion of our role as biologists in understanding and promoting consilience in the natural sciences and with the humanities.

My thanks to the Executive Committee and the members of ASB for their support and willingness to contribute to every aspect of this organization during my term as President.



Home of the Department of Biology



Water tower near Friday Hall (Marine Biology)

**PROGRAM of the
60th ANNUAL MEETING of the
ASSOCIATION OF SOUTHEASTERN BIOLOGISTS**

Hosted by

UNIVERSITY OF NORTH CAROLINA-WILMINGTON

at the

Hilton Hotel

and the

Coastline Convention Center

and the

University of North Carolina-Wilmington Campus

Wilmington, North Carolina

SOCIETIES MEETING WITH ASB IN WILMINGTON

American Society of Ichthyologists and Herpetologists
Southeastern Division (ASIH)

Beta Beta Beta (BBB)

Botanical Society of America, Southeastern Section (BSA)

Ecological Society of America, Southeastern Chapter (ESH)

Society of Wetland Scientists (SWS)

South Atlanta Chapter

Southeastern Fishes Council (SFC)

Southern Appalachian Botanical Club (SABS)

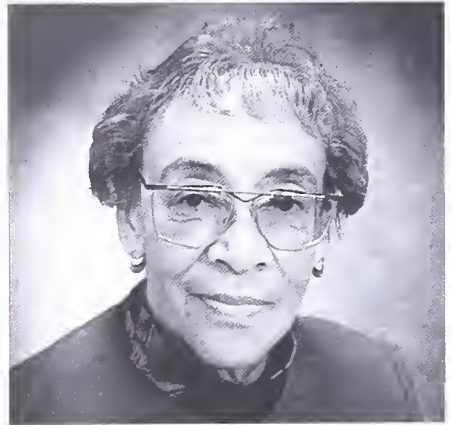
ASB CANDIDATES FOR OFFICE - 1999

The Nominating Committee, composed of Chair, Jim Fralish, Beverly Collins, and Mike Baranski has selected the following slate of nominees for the ASB offices to be filled in 1999. Additional nominations will be received for the floor. ***Voting will take place in the annual business meeting at 11:30 AM, Friday, 16 April, 1999. Please plan to attend.***

<i>President Elect</i>	Howard Neufeld	Appalachian State University Boone, North Carolina
	Geraldine Twitty	Howard University Washington, D.C.
<i>Vice President</i>	Phil Robertson	University of Southern Illinois Carbondale, Illinois
	Dwayne Wise	Mississippi State University Starkeville, Mississippi
<i>Treasurer</i>	Tim Atkinson	Carolina Biological Supply, Co. Burlington, North Carolina
<i>Executive Committee</i>	Dan Evans	Marshall University Huntington, WV
	Gerhard Kalmus	East Carolina University Greeneville, NC
	Bonnie A, Kelley	The University of North Carolina at Pembroke, Pembroke, NC
	Lisa Wagner	South Carolina Botanical Garden, Clemson University, Clemson, SC



Howard Neufeld



Geraldine Twitty

PRESIDENT

Geraldine W. Twitty - Dr. Twitty is Professor of Biology in the College of Arts and Sciences at Howard University in Washington, DC. She received her B.S. in Zoology, the M.S. in Parasitology and Ph.D. in Biochemical Genetics at Howard University. She has studied additionally at UCLA, the Bermuda Biological Station, and participated in workshops on Recombinant DNA [NIH], DNA Technology [Cold Spring Harbor], Geographic Information Systems and Environmental Science workshops. She has pursued Biology in the Galapagos Islands, Hawaii and Australia. She is a member of the National Advisory Board for the Oklahoma Teacher Education Collaborative (University of Tulsa). Her classroom experiences include General Zoology, General Biology, Histology and Invertebrate Zoology. In 1990, her work in designing effective classroom material resulted in the publication of a series of modules entitled, *Contemporary Zoology*. During her tenure at Howard, she has worked with the Office of Pre-professional Education in the design and implementation of MCAT/DAT reviews as well as classes for Pre-college students and served as the Chair of Comprehensive Science Programs. A recent sabbatical leave was spent in the Office of Environmental Justice, U.S. Environmental Protection Agency. Dr. Twitty has been active in ASB since 1986 and has served for a decade as the ASB representative to AIBS. She also holds membership in AAAS, AIBS, and Sigma Xi. Her decade-long participation with the Sigma Xi Qualifications Committee ended recently with her election to a three year term as a Director-at-Large. She is also active with the DC Coalition for Environmental Justice and the Minority Women in Science.

ASB has always been at the forefront of efforts to expand avenues of new knowledge and to provide collaborative participation and mentoring; yet opportunities for fostering broader interactions among institutions, for establishing more effective pipelines and for enhancing career development are needed. It is also imperative that we demonstrate our commitment to sustaining biological research by ensuring that our banner waves continuously at Congressional doors. The future of our society depends upon the extent to which the beneficial aspects of research are reflected in appropriations in support of that research.

Dr. Howard S. Neufeld. Dr. Neufeld received his B.S. in Forestry from Rutgers University in 1975, his M.F. in Forest Sciences from the Yale School of Forestry and Environmental Science in 1977, and his Ph.D. in Botany from the University of Georgia in 1984. He was a post-doctoral fellow at New Mexico State University under Dr. Gary Cunningham from 1984-1985, working on the ecophysiology of range grasses and creosote bush. In 1985 he began an NRC post-doctoral appointment under Drs. Dave Tingey and Bill Hogsett at the EPA Lab in Corvallis, OR. While there, he worked on the effects of ozone on root growth of tree seedlings. After two

years, he came back to the University of Georgia as a research coordinator in the Forestry School before accepting a position as Assistant Professor of Biology at Appalachian State University. Currently he is Professor of Biology and Chair of the Faculty Senate.

Dr. Neufeld has been very active in ASB affairs, having served on the Executive Committee (1994-1996), the Place of Meeting Committee (as Chair for one year), the Local Arrangements Resolution Committee, and the Patron Members & Exhibitors Committee. He served as Vice President of the Society from 1997-1998. In 1991 he was the Program Chair when the annual meeting was hosted by Appalachian State University. He currently maintains the website for ASB.

His research expertise is in the area of plant physiological ecology, and has included work on desert plants and understory tree adaptations to shade. For the past 15 years, he has been active in air pollution research, including the effects of acidic deposition (rain and fog) on spruce trees and hardwoods of the eastern United States, and ozone on native plants. From 1988-1992 he was the principal investigator of a National Park-U.S. EPA sponsored research project on the effects of ozone on plants native to Great Smoky Mountains National Park. These results have been published in a variety of journals, and additional papers are in press now. He received the Faculty Research Award from ASB in 1992, and one of his graduate students won both the Odum and Student Research Awards recently. He has served as major advisor on five Masters theses, and currently directs four graduate students who work on a variety of projects, such as grazing effects in mountain bogs, heavy metal toxicity in cypress trees, water relations of *Galax* plants, and patterns of herbivory in *Rhododendrons*.

When he's not working on Faculty Senate matters, teaching or research, he plays euphonium in the community band, and enjoys raising his two kids, ages 10 and 20 months.

VICE PRESIDENT

Dwayne A. Wise - Dr. Wise is Professor of Biological Sciences and Graduate Coordinator at Mississippi State University. A native of Tennessee, he attended the University of the South and David Lipscomb College before receiving the Master's (1968) and Ph.D. degrees (1972) from Florida State University. He was a postdoctoral fellow at the University of Texas Health Science Center at Dallas and was a Temporary Instructor at Duke University. He has been a faculty member at MSU since 1979, where he teaches genetics, cell biology and botany. He is a member of the American Society for Cell Biology, the American Genetics Association, the Genetics Society of America, Sigma Xi, Phi Kappa Phi, is an honorary member of the Beta Beta Beta, and is a member of the American Association of University Professors and the Association of Southeastern Biologists.

He has been a member of ASB since 1968. He has served on the ASB Executive Committee since 1996 and has been chair of the faculty award committee twice. His research interest is to understand chromosome structure and behavior, especially in living cells. This includes the mechanism of chromosome movement, ways in which chromosome structure and behavior may be approached experimentally and the analysis of meiosis in organisms with unusual modes of chromosome distribution. He has been a Visiting Professor in the Department of Cell Biology, Baylor College of Medicine, Houston, Texas and at the University of North Carolina at Chapel Hill. He was named Outstanding Faculty Member by the MSU Student Association in 1987, and the Margaret Y. Menzel Memorial Lecturer at the Boone Chromosome Conference in 1989. He received the ASB Faculty Research Award, in 1991 and was the Goodman Visiting Scholar at Peace College, Raleigh, NC in 1991. He has served on grant panels for the National Institutes of Health, the National Science Foundation, the International Human Frontier Science Program, the Italian Ministry of Science, the Charles A. and Anne Morrow Lindeberg Foundation, and the US- Israel Binational Science Foundation. He has reviewed manuscripts for numerous professional journals and his research has been supported by the NIH, NSF, USDA, and NATO.

Philip A. Robertson – Dr. Robertson is Professor of Plant Biology at Southern Illinois University Carbondale. He received his B.S. in Forestry and Range Management (1962), his M.S. in Range Science (1964) and his Ph.D. in Plant Ecology (1968) from Colorado State University. He taught at the State University College of New York at Oneonta before becoming a faculty member at SIUC. His research interests lie in the area of soil/site relationships of forest species and communities in both upland and lowlands of the Central Hardwoods region. In addition, he has conducted research on the effects of fire in upland oak-hickory communities, dendrochronology of lowland forest tree species and characteristics of old-growth forests both in the Midwest and Rocky Mountains. He has been an active member of ASB since 1971 and served on the Executive Committee from 1995-1998. He is also a member of Ecological Society of America, Sigma Xi, The International Association for Vegetation Science, Torrey Botanical Society and Illinois Academy of Science.

TREASURER

Timothy A. Atkinson - Tim is section Head of Preserved Materials at Carolina Biological Supply Company, Burlington, NC. He received his A.S. (1971) in physical education and biology from Gadsden State Junior College, Gadsden, Alabama, B.S. (1974) in biology and physical education, and M.S. (1977) in biology from Jacksonville State University, Jacksonville, Alabama, and studied Ecosystematics

under A. E. Radford at UNC-Chapel Hill until starting at Carolina Biological Supply (1980). He has Performed contract work for the U.S. Department of Defense, U.S. Department of Energy, U.S. Forest Service, U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, The Nature Conservancy, and many private researchers. He has published steadily for over 20 years, including books, journal articles, videos. and, most recently, in volumes 2 and 3 of *The Flora North America*. He first became involved in ASB as a student in 1974 and currently holds an individual membership as well as representing the patron membership of Carolina Biological Supply Company.

EXECUTIVE COMMITTEE AT LARGE

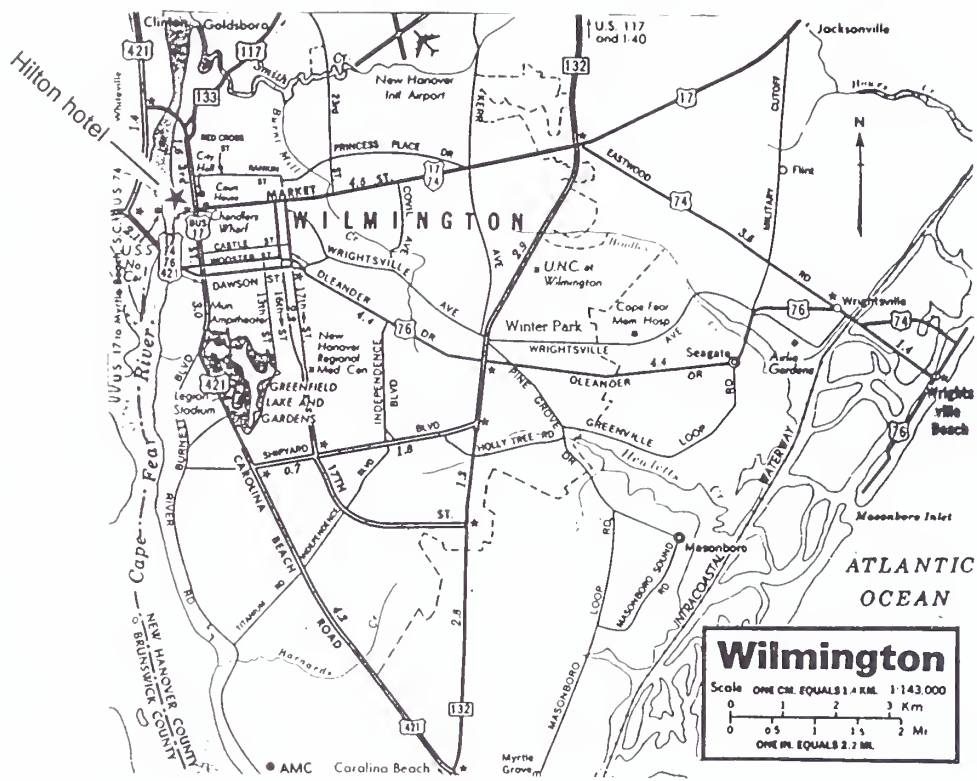
Lisa Wagner is Director of Education/Associate Professor at the South Carolina Botanical Garden, Clemson University. She received her B.A. degree in Plant II (Biology) from the University of Texas at Austin in 1976 and her Ph.D. in Botany from the University of California at Berkeley. A plant ecologist, she was a post-doctoral fellow at the University of Osnabruck in 1983-84 and at the Smithsonian Institution's Environmental Research Center (1984-85). She joined the Department of Biology faculty at Georgia Southern University in 1985, where she served as Assistant and Associate Professor and as founding Director of the Georgia Southern University Botanical Garden. At Clemson University since 1994, her grant-supported activities include ecological and plant conservation research on native grasses and herbaceous perennials and a major informal science education program, Garden Explorations, funded by the Howard Hughes Medical Institute. Her professional interests include ecology and population biology of plants, conservation biology and ecology, science education and environmental education, landscaping with native plants, and reproductive allocation patterns in plants. She has been an active member of ASB since 1985, in addition to the Botanical Society of America, the Ecological Society of America, American Association of Botanical Gardens and Arboreta, and the Society for Ecological Restoration. She serves as program chair for the South Carolina Native Plant Symposium, co-sponsored by the SC Native Plant Society.

Bonnie A. Kelley - Dr. Kelley is Professor and Chair of Biology at The University of North Carolina at Pembroke. She received her B.S. degree in Biology at North Georgia College, and her Masters in Science Education and Ph.D. in Plant Pathology at The University of Georgia. She has been on the Biology faculty at UNC Pembroke for 21 years, Chair of the department for a year and a half. Dr. Kelley has received funding from several sources including NSF and Howard Hughes Foundation for training programs for minorities in Biology. She received the UNC Board of Governors Award for Teaching Excellence in 1995. She is a member of the

NC Academy of Science, National Science Teachers Association, and ASB. She served on the Women, Minorities, and Disabled Persons Committee of ASB for three years, serving as Chair in 1995. She has judged many student papers at ASB meetings to help her colleague Andy Ash when he was chairing that committee. Having given her heart and soul to the teaching of Biology at a small, regional institution with no graduate program, Dr. Kelley's interests center around teaching methodology, funding labs and undergraduate research projects, and trying to keep current in Plant Physiology.

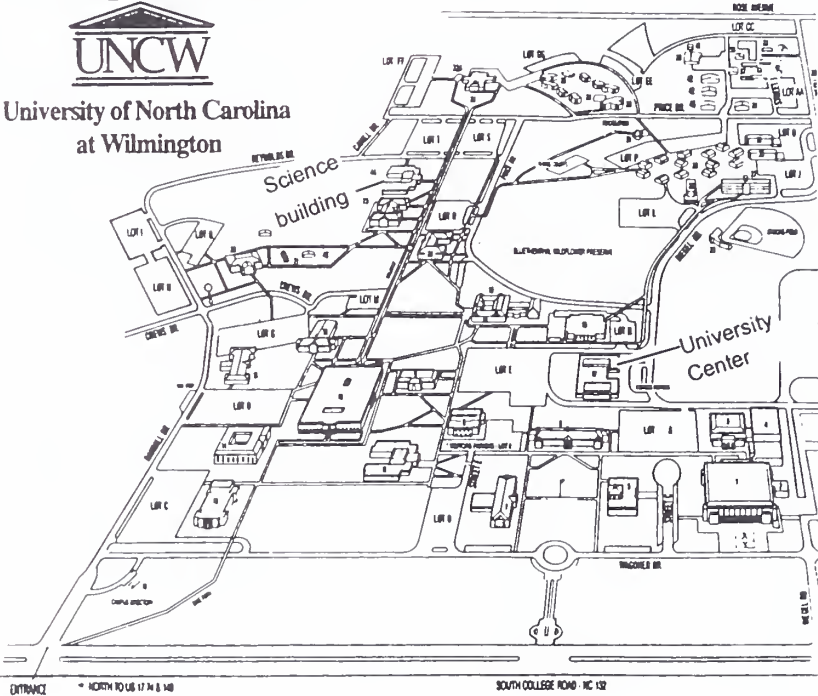
Gerhard W. Kalmus - Dr. Kalmus is a Professor, Director of Graduate Studies and the Health Professions Advising Office in the Department of Biology at East Carolina University, Greenville, NC. He received his B.A. degree in German from the University of California at Berkeley (1967), his MS degree in Biology from Rutgers University at Camden, NJ (1974) and his Ph.D. degree in Zoology from Rutgers University at New Brunswick, NJ (1977). His research interests include mechanisms of neurulation, the effect of alcohol on growth parameters during early embryonic development, and expression of cell surface molecules during morphogenesis. He has been an active member of the ASB since 1977 and has served on the Graduate Student Support Award Committee, the Patron Members and Exhibitors Committee and as Treasurer. He is a member of Sigma Xi (President of the local chapter), AAAS, Society for Developmental Biology, and other professional societies. He serves as secretary of the North Carolina Academy of Science, co-director of the Student Academy in District VII, and faculty advisor to Alpha Epsilon Delta.

Dan K. Evans. Dr. Dan Evans is Professor of Biological Sciences and Curator of the Herbarium (MUHW) at Marshall University in Huntington, West Virginia. He received his B.S. in Chemistry from Murray State University (KY) in 1961 and the M.S. and Ph.D. degrees in Botany from Southern Illinois University in 1971 and 1975, respectively. During 25 years at Marshall University his research has focused on systematics of higher plants, the West Virginia flora, wetlands, and ethnobotany. During nine research visits to Ecuador he has studied the medicinal plants used by the Shuar and Achuar people of the southeastern rain forest. In addition, Dr. Evans teaches courses in plant taxonomy, wetland science, economic botany, and introductory biology. He and his 25 graduate students have published papers and abstracts in the ASB Bulletin, the journal *Castanea*, *Rhodora*, *Wetland Ecology and Management*, *Journal of Environmental Quality*, *Proceedings of the West Virginia Academy of Science*, and in US Army Corps of Engineer publications. Dr. Evans has served as an editor of the journal *Castanea*, a member of the Nominating Committee and as a Member at Large of the SABC. He is also a member of NEBC, ASPT, SEB, and a lifetime member of the West Virginia Native Plant Society.



Campus Map

UNCW
University of North Carolina
at Wilmington



GENERAL INFORMATION

Registration: - Registration information and the pre-registration form were published in the January 1999 issue of the **ASB Bulletin**. Preregistrants may pick up their registration packet at the ASB registration desk. The registration desk will be located at the lobby of Wilmington Hilton Wednesday April 14, noon to 5.00 PM, Thursday April 15 from 8 AM to 5 PM and Friday April 16 from 8 AM to noon. Please bring your April issue of the ASB bulletin to the conference. Additional copies will be for sale at the registration desk at a cost of \$5.00. For any information about the program please contact Dr. Frank Schwartz at the Institute of Marine Sciences, 3431 Arendell Street, Morehead City, North Carolina 28557: (252-726-6841).

Host Institution: The University of North Carolina at Wilmington will be our host institution and the Department of Biological Sciences will take active part in hosting this meeting. For a detailed information about the host institution and the city of Wilmington, please see the website : <http://www.uncwil.edu/bio/asb/asbprog.htm> and read the descriptions given in the January 1999 issue of the ASB Bulletin.

Ground Travel: A map of Wilmington is printed in this ASB bulletin. Wilmington is located in the southeast part of North Carolina on the banks of Cape Fear River. The city is easily accessed by I-40 East. If you drive along the coast from the south take HWY 17 North and from the north take HWY 17 South to reach Wilmington. I-95 also intersects I-40, not too far from Wilmington.

Air Travel: Wilmington International Airport is located at the edge of the city. Delta Airline, US Airways, American Airlines etc. fly in and out of Wilmington. Please call Vic or Birgit of the Allen Travels in Wilmington for handling your airline reservations and ticketing at discounted rates (1-800-849-6500 or 910-395-6500 or Fax 910-392-5841.) You may also decide to make your own travel arrangement that suits you.

Parking: Only those participants, who are staying at the Hilton, can park there. All other will have to pay on the basis of the duration. There are street parking lots but it is difficult to park there during work hours (8 am to 5 PM). If you are staying in a hotel within walking distance from Hilton, it is advisable not to drive to Hilton. Transportation by bus will be arranged for all participants to the Thursday evening social to the campus from the Hilton.

Job Placement and Message Boards: Position notices and messages will be displayed near the ASB registration desk in the Hilton.

Local Restaurants: Your registration package will contain a list of recommended restaurants in down-town in the vicinity of the Hilton in the River Street and Water Street, and also at Wrightsville Beach.



Hilton Wilmington Riverside



Social Activities and Events: Tickets for social events will be included in the registration packets for those who have pre-registered for the events. Times and places for activities and meals are given in this bulletin and on the program schedule on the web site (<http://www.uncwil.edu/bio/asb/asbprog.htm>). A limited number of tickets may be available at the registration desk for those who did not pre-register.

Some Conference Highlights: This 1999 ASB conference includes two symposia that are dedicated to biodiversity and conservation. The key-note speaker will be Prof. E.O. Wilson, an author of a well-known book on "Biodiversity". On April 15 there will be a full day SABS/ASB symposium on "Southeastern Endemics: Speciation and Biogeography" that is coordinated by Dr. Zack Murrell. On April 16 there will be a symposium on "Coastal Ecology" that is coordinated by Dr. Mike Durako and Dr. Robert George. There will be an "Information Booth", organized by the Society of Conservation Biology, Southern Appalachian Chapter. For details of the symposia and workshops, please go through the program given in this *ASB Bulletin*. On April 14, 1999 the North Carolina Chapter of the Fulbright Association, as endorsed by ASB, will present to Prof. E.O. Wilson the "George Deacon Medal" for significant contributions to interdisciplinary knowledge.

Wednesday Evening Social and Reception for Professor E. O. Wilson: A social with cash bar will held between 8:30 and 10 PM at the swimming pool area of the Hilton. Soft drinks and snacks will be served and the cost for the snacks is included in your registration fee. Music will be provided with a violinist and a guitarist. Our key-note speaker Prof. E. O. Wilson will also participate in this ASB social.

Thursday Evening "Gala" at UNCW: We will hold a reception for ASB participants between 6:30 PM and 9 PM at the Warwick Center Ball Room at UNCW. The menu will have typical "Tar Heel Flavor" with lots of goodies as refreshments. Of course there will be plenty of liquid to quench your thirst: Coke, Pepsi, Beer and Wine. Adjacent to the University Ball Room is the *Center Cafe* where live music will be provided with a local band. Shuttle bus service between the Hilton and the campus will begin at 5.45 PM.

Friday Evening Banquet: The ASB banquet will be held from 6:30 -8:30 PM in the Hilton Banquet Hall. There will be a choice of Fish/Chicken or Vegetarian entree.

Field Trips: All field trips will depart from Hilton parking lot. Details of the field trips are available in the January issue *ASB Bulletin* and on the web site. The following five field trips will be coordinated on April 17 by Dr. Courtney Hackney: (1) Fort Fisher Aquarium Trip (2) Black River Canoe Trip (3) Smith Island Trip (4) Tidal Marsh-Cape Fear River Trip and (5) Green Swamp Trip.

Local Arrangement Committee (Area code 910):

Local Arrangement Chair:	Robert Y. George	962-3611
	GeorgeR@uncwil.edu	fax 962-4066
Program Chair	Frank Schwartz	252-726-6841
		fax 252-726-2426
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	Hosier@uncwil.edu	
	&	
	Anne Kenderick	910-962-7417
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Social Arrangement	Stephen Kinsey	910-962-7398
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Commercial Exhibits	David Webster	910-962-3756
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	David Lindquist	910-962-3474
	Lindquist@uncwil.edu	
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	Potts@uncwil.edu	
Workshops Coordinator	Tom Shafer	910-962-7275
	Shafert@uncwil.edu	

PLENARY SPEAKER

**Dr. Edward O. Wilson**

Our Plenary Speaker this year is Dr. E.O. Wilson, Honorary Curator in Entomology, Museum of Comparative Zoology at Harvard University and Pellegrino University Research Professor. Dr. Wilson is one of the giants in this broad field that we call biology. He has been instrumental in forming the concepts of island biogeography, sociobiology, chemical communication, and the study of character displacement. He helped popularize the term "biodiversity" and has championed the preservation of the world fauna and flora. His *curriculum vitae* indicates over 370 scientific papers, five of which have been recognized as Science Citation Classics. His doctoral work was completed at Harvard University where he worked with ants, a passion that he developed in Alabama when he was a child. Extensive work in the New Guinea, as well as other island groups, drew his attention to the dynamics of island populations. In a most unusual move, Harvard hired him, one of their own graduates, in a tenure track position, a position that he has held to this day.

Dr. Wilson's c.v. lists 24 awards for outstanding scientific contributions, including the National Medal of Science (1976), the William Proctor Prize for Scientific Achievement given by Sigma Xi (1997), the Crafoord Prize of the Royal Swedish Academy of Sciences (1990), the Japanese government's International Prize for Biology (1993), the first recipient of the Edward Osborne Wilson Naturalist Award of the American Society of Naturalists (1997), and he was named Eminent Ecologist by the Ecological Society of America (1994). His c.v. also lists sixteen literary awards, including two Pulitzer Prizes, both for General Non-Fiction. One was for *On Human Nature*, published in 1978 and awarded the Pulitzer Prize in 1979, and the other for *The Ants*, published in 1990 and awarded the Pulitzer Prize in 1991. His numerous other awards include many for conservation and two for outstanding teaching at Harvard. He is a member of the National Academy of Sciences, the Royal Society of London, and the Russian Academy of Natural Science, to name but three. Dr. Wilson was named one of the 100 most influential scientists of all time in the book *The Scientific 100* by John Simmons and one of America's 25 Most Influential People by *Time Magazine* (June 17, 1996). Books that he has authored or co-authored include *The Theory of Island Biogeography* with R.H. MacArthur (1976), *The Insect Societies* (1971), *Sociobiology: the New Synthesis* (1975), *Promethean Fire* with C.J. Lumsden (1981), *Naturalist*, an autobiography (1994), and *Consilience* (1998), as well as sixteen other titles.

Although he currently resides in Massachusetts, Dr. Wilson might be called a "true child of the South." As a boy, he lived in Alabama, Florida, Washington, D.C., and Georgia, attended school in Mississippi and spent summers in Virginia and Maryland. He has been influenced by biology in the Southeast, his life-long interest in nature beginning on the Gulf of Mexico shores of Florida and Alabama. He completed his B.S. (1949) and M.S. (1950) degrees at the University of Alabama in Tuscaloosa. In *Naturalist*, Dr. Wilson speaks of Herb Boschung, Henry Walker and Ralph Chermock, names very familiar to biologists in the Southeast. Some of his former students have been vital members of the community of biologists in our region, such as Dan Simberloff who did some of the early work on island biogeographic theory in the Florida Keys.

We welcome this outstanding biologist whose roots are in the South, but whose influence is worldwide.

PROGRAM SUMMARY

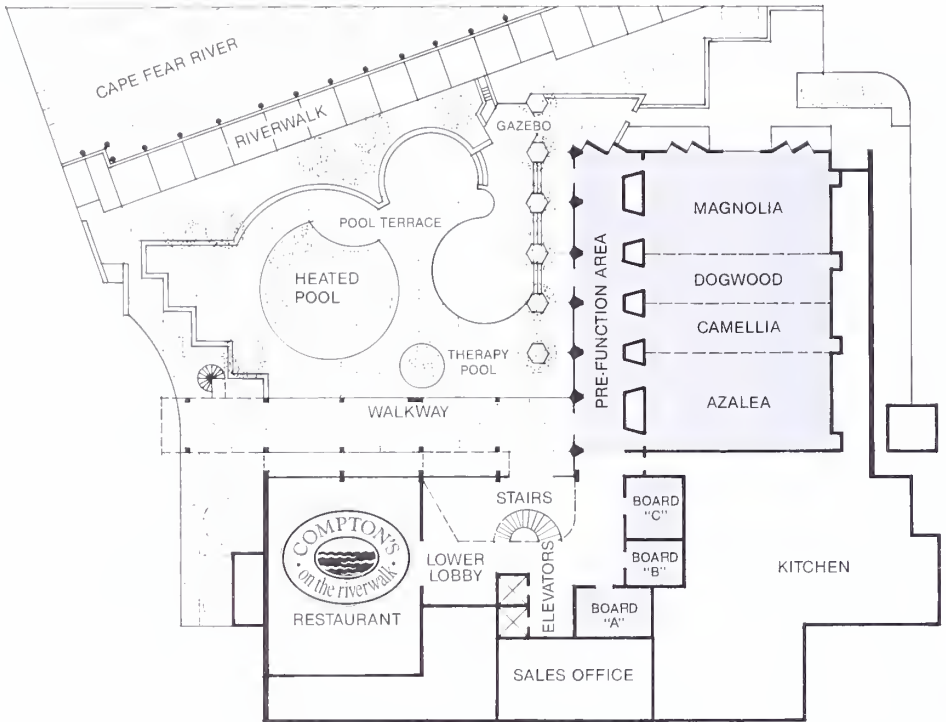
All events will be held at the Hilton Hotel, Coastline Convention Center, and on the UNC-Wilmington campus. See floor plans for the Hilton and Convention Center in this issue.

WEDNESDAY 14 APRIL 1999

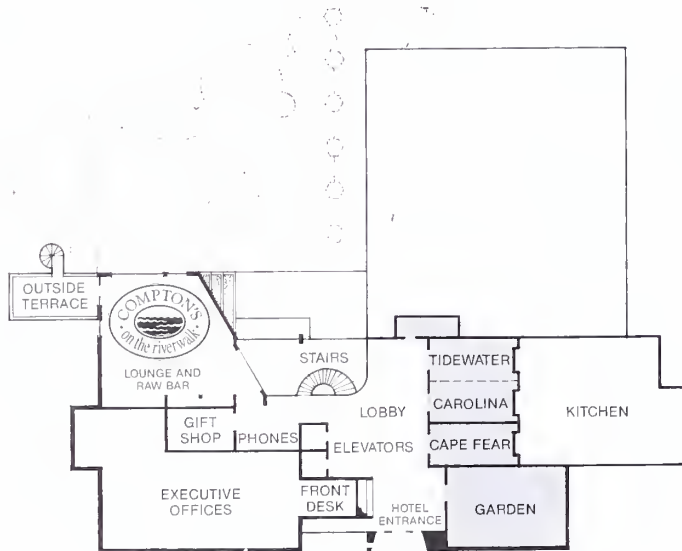
- Noon-5:00 PM **Registration, Lobby Hilton**
- 3:00 - 7:00 PM **ASB Executive Committee Meeting - Tidewater/Carolina Rooms, Hilton**
- 7:00 - 8:30 PM **ASB Plenary Session Magnolia Ballroom, Hilton**
 Dr. R. George - Convenor - General Comments
 Dr. Frank Schwartz - Program and location of rooms in Hilton and Convention Center
 Dr. James Leutze - Chancellor - UNC-Wilmington, Welcome
 Dr. Eloise Carter - President ASB, Response
 Dr. R. George - Award of "Sir George Deacon" medal to Prof. E. O. Wilson, by the North Carolina Chapter of the Fullbright Association.
- Plenary Lecture: Dr. E. O. Wilson, Harvard University.
 "The Relation of Biology to Humanities"
- 8:30 PM-10:00 **ASB Social - Hilton Pool Area *PLEASE NOTE!* The social follows the plenary address, and does not precede it, as was announced in the January issue of the ASB Bulletin.**

THURSDAY 15 APRIL 1999

- 7:00 - 8:00 AM **ASB Past President's Breakfast - Tidewater/Carolina Rooms, Hilton**
- 7:00 - 8:30 AM Poster and Exhibits set ups, *Hilton*
 Posters-Dogwood Room, Presenters with their posters 10:30 - 11:30 AM. Dismantle all posters by 5:00 PM Thursday
- 7:00 AM-5:00 PM Exhibitors set up and viewing - *Azalea Room, Hilton*
- 7:00 AM-5:00 PM Slide previewing - *Board Room C, Hilton*
- 8:00 AM-5:00 PM Registration, *Lobby Hilton*



First Floor Plan of the Hilton



Second Floor Plan

8:00 AM-5:00 PM	Posters - <i>Hilton</i>
8:00 AM-5:00 PM	SABS/ASB Symposium - "Southeastern Endemics: Speciation and Biogeography" Dr. Zack Murrell Convenor, <i>Magnolia Room, Hilton</i>
8:00 - 10:30 AM	Workshop , sponsored by ASB and the Education Committee, "Introductory Biology: Curriculum and Laboratory" Dr. R. George, Chair: Dr. S. Vogel: Speaker, <i>Convention Center, Room A</i>
10:30 AM-1:00 PM	Workshop sponsored by ASB Committee on Women, Minorities, and the Disabled, and the ESA/SE Chapter - Dr. H. Bart, Chair, NSF Speakers - <i>Convention Center Room A</i>
11:30 AM-1:00 PM	Society of Wetland Scientists and Consortium for Southern Forested Wetlands, Lunch <i>Tidewater/Carolina Rooms Hilton</i>

Morning Paper Sessions

8:00 - 11:15	Aquatic Ecology - Session 1 <i>Convention Center Room D</i>
8:00 - 10:00	Invertebrate Biology <i>Convention Center Room B</i>
8:00 - 9:30	Aquatic Wetlands/Ecology - Session 1 <i>Convention Center Room C</i>
9:30 - 11:30	Ichthyology - Session 1 <i>Convention Center Room C</i>
10:30 - 12:00	Herpetology - Session 1 <i>Convention Center Room B</i>

Afternoon Paper Sessions and Events

12:45-3:00	Plant Ecology - Session 1 <i>Convention Center Room D</i>
1:00-4:00	Ichthyology Session 2 <i>Convention Center Room C</i>
1:00 - 3:15	Herpetology Session 2 <i>Convention Center Room B</i>
1:00-4:30	Microbiology and Parasitology <i>Convention Center Room A</i>
3:30-5:30	Plant Ecology - Session 2 <i>Convention Center Room D</i>
4:00 - 5:15	Teaching Biology <i>Convention Center Room B</i>
1:00 PM-5:00 PM	BBB Field Trip to NC Aquarium-Ft. Fisher , Departs front of Hilton
4:00 PM-6:00 PM	Herbarium Curator's Meeting , <i>Tidewater/Carolina Rooms, Hilton</i>
4:00 PM-4:30 PM	ASIH-SE Division Business Meeting , <i>Convention Center Room C</i>
4:30 PM-5:30 PM	Southeast Fisheries Council , <i>Convention Center Room C</i>
5:30 PM-9:00 PM	ASB Social at <i>UNC-Wilmington, Warwick Center Ballroom</i> . Buses leave Hilton beginning at 5:45 PM <u>Promptly</u> .

FRIDAY 16 APRIL 1999

7:00 AM-8:30 AM	SABS/SE section Breakfast and Business Meeting <i>Hilton Lounge</i>
7:00 AM-5:00 PM	Slide previewing, <i>Board Room C, Hilton</i>
8:00 AM-1:00 PM	Exhibits: <i>Azalea Room, Hilton</i>
8:00 AM-Noon	Registration, <i>Lobby, Hilton</i>
8:00 AM-5:00 PM	Paper sessions- <i>Hilton and Convention Center</i>
8:30 AM-1:00 PM	Symposium on "Coastal Ecology," coordinated by Drs. Michael Durako and Robert George, <i>Magnolia Room, Hilton</i>
8:30 - 10:30 AM	BBB Officer and Judges Meeting - <i>Tidewater/ Carolina Rooms, Hilton</i>

Morning Paper Sessions

8:00-10:45	Cryptogamic Botany <i>Convention Center - Room A</i>
8:00-11:30	Plant Systematics <i>Convention Center Room C</i>
8:00-11:30	Plant Ecology - Session 2 <i>Convention Center Room D</i>
11:30 AM-12:30 PM	BBB Luncheon - <i>Front Street Brewery</i>
11:30 AM-12:30 PM	ASB ANNUAL BUSINESS MEETING AND ELECTION OF OFFICERS - <i>Convention Center, Room D Hilton</i>
12:30 - 1:30 PM	Ecological Society of America, SE Chapter Lunch - <i>Hilton Lounge</i>

Afternoon Paper Sessions and Events

1:30 - 4:00 PM	BBB Sessions, <i>Convention Center Rooms A, B, C</i>
4:30 - 5:30 PM	BBB Officer and Judges Meeting <i>Convention Center Room A</i>
1:00-5:30	Continuation of Plant Ecology - Session 2 <i>Convention Center Room D</i>
10:45-11:30	Developmental Biology <i>Convention Center - Room A</i>
1:00-5:30	Aquatic/Wetland Ecology <i>Hilton Hotel - Magnolia Room</i>
1:00-3:15	Animal Ecology <i>Hilton Hotel - Azalia Room - Session 2</i>
1:00-2:30	Plant Physiology <i>Hilton Hotel - Dogwood Room</i>
2:30-3:00	Evolution <i>Hilton Hotel - Dogwood Room</i>
3:30-4:30	Mammal Biology - <i>Dogwood Room</i>
3:30-4:45	Cellular/Molecular Biology <i>Hilton Hotel - Azalia Room</i>
4:15-5:30	Animal Physiology <i>Convention Center Room C</i>
6:30 - 8:30 PM	ASB Banquet and Awards, <i>Hilton Ballroom</i>

SATURDAY 17 APRIL 1999

7:30 - 10:00 AM **ASB EXECUTIVE COMMITTEE MEETING**
Tidewater/Carolina Rooms, Hilton

Field trips depart from the Hilton

6:00 - 11:30 AM	Fort Fisher Aquarium Trip	\$8
7:30 AM - 4:30 PM	Black River Canoe Trip	\$53
7:30 AM - 4:30 PM	Smith Island Trip	\$50
6:00 AM - Noon	Tidal Marsh-Cape Fear River Trip	\$8
8:00 AM - Noon	Green Swamp Trip	\$15

CALL FOR NOMINATIONS FOR EDITOR OF THE *ASB Bulletin*

The Executive Committee of the Association of Southeastern Biologists would like to receive applications and/or nominations for editor of the *ASB Bulletin*. The successful candidate will assume editorial duties beginning with Issue 3 of Volume 47 (September, 2000). If you have any publication experience or interest, or if you know someone in ASB who does and who you think would be a good candidate, please send the information by 15 May to

Pat Parr
ORNL Area Manager
Environmental Sciences Division
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, Tennessee 37831-6038

ASB PAPER AND POSTER SESSIONS

THURSDAY 15 APRIL 1999

POSTERS - DOGWOOD ROOM - HILTON

**Posters displayed 8 am - 5 pm,
Presenters with posters 10:30 - 11:30 am
Dismantle posters by 5 pm Thursday.**

ANIMAL ECOLOGY

1. **Tuberville, Tracey D., J. Russell Bodie, John B. Jensen, Linda Laclaire, J. Whitfield Gibbons.** University of Georgia's Savannah River Ecology Laboratory, University of Missouri- Columbia, Georgia Department of Natural Resources, and U.S. Fish and Wildlife Service - Ecology and perceived decline of the southern hognose snake, *Heterodon simus*.
2. **Phillips, Gary And Samrrah A. Raouf.** Department of Biology, Coastal Carolina University, Conway, SC 29528. Avifauna survey of an Atlantic Coast Barrier Island.
3. **Whitekiller, Robin R., David F. Westneat, Patricia L. Schwagmeyer And Doug W. Mock.** Dept. of Zoology, University of Oklahoma, Norman, OK 73019 and Dept. Biological Sciences, University of Kentucky, Lexington, KY 40506 - Badge size and extra-pair fertilizations in the house sparrow, *Passer domesticus*.
4. **Ritland, David b.** Erskine College, Due West, SC 29639. Mayhem in the Monarch's Court: Viceroy (*Limenitis archippus*) Mimicry Revisited.
5. **Edwards, Mary Lang And David Rutland.** Erskine College, Due West, SC 29639. Home Range of an Eastern Box Turtle, *Terrapene c. carolina*, on a residential island habitat.
6. **Marvin, Glenn a.** Dept. of Zoology, University of Oklahoma, Norman, OK 73019 and current address Dept. Biology, University of Montevallo, Montevallo, AL 35115. Territorial behavior of the salamander *Plethodon kentucki*: influence of habitat structure and population density.

7. **Joplin, Karl H. And Darrell Moore.** Dept. Biological Sciences - 70703, East Tennessee State University, Johnson City, TN 37614. Behavioral chaos within groups of nonsocial flies?

AQUATIC WETLANDS

8. **Shacochis, Kristen, Jeffrey Deberry, Darren Loomis, Robert Belcher And Robert Atkinson.** Dept. Biology, Chemistry and Environmental Science, Christopher Newport University - Plant composition within a chronosequence of Atlantic White Cedar, *Chamaecyparis thyoides*, wetlands in Virginia and North Carolina.
9. **Belcher, Robert T., Travis R. Comer And Robert B. Atkinson.** Dept. Biology, Chemistry, and Environmental Science, Christopher Newport University. Morphometric and physiological responses to shading in Atlantic white cedar, *Chamaecyparis thyoides* (L.) B.S.P. cuttings.
10. **Corn, Elizabeth, Robert Angus, And Ken Marion.** University of Alabama at Birmingham. Benthic macroinvertebrate community indices in tributaries of the Cahaba River in Alabama: effects of urbanization.
11. **Gregory, Jarrett A., B. Schlomer, Karl H. Joplin.** Dept. Biological Sciences - 70703, East Tennessee State University, Johnson City, TN 37614. Stress effects of environmental contaminants in freshwater organisms.
12. **Patti, Heather d.** Department of Botany, North Carolina State University. Effects of an altered hydrological regime on species composition and tree productivity in a bottomland hardwood forest, Sampson County, North Carolina.
13. **Conner, William H., L. Wayne Inabinette, And Carrie Cuthbertson.** Baruch Forest Science Institute, Box 596, Georgetown, SC 29442. Invasion of South Carolina wetland forests by an unwanted exotic - Chinese tallow.
14. **Faulkner, Samuel P. And Robert A. Stewart.** Dept. Biological Sciences, Delta State University, Cleveland, MS 38733. Relationship of soil physicochemical composition to growth of black needlerush (*Juncus roemerianus* Scheele) in northern Gulf of Mexico wetlands.
15. **Ritchie, Jerry c.** USDA ARS Hydrology Laboratory, Beltsville, MD 20705. Grass hedges for erosion control.

16. **Vilmenay, Annick, Aderonke Ajala, Raymond L. Petersen And Richard M. Duffield.** Dept. of Biology, Howard University, Washington, DC 20059. Foreign mosquito survivorship in the purple pitcher plant, *Sarracenia purpurea* L. (Sarraceniaceae).
17. **Stephenson, Steven L., Yuri K. Novozhilov, And Adam W. Rollins.** Dept. Biology, Fairmont State College, Fairmont, WV 26554 and V.L. Komarov Botanical Institute, 197376 St. Petersburg, Russia. Occurrence and distribution of myxomycetes in tropical forests of Puerto Rico.
18. **Funderburke, Lisa, Raymond L. Petersen, And Lafayette Frederick.** Preliminary investigation of probable mycorrhizal associations in the roots of the cinnamon fern *Osmunda cinnamomea* L.

CELL/MOLECULAR BIOLOGY

19. **Hamilton, Heather C. And James R. Garey.** Department of Biology, University of South Florida, Tampa, FL 33620. Applying molecular techniques to environmental studies of meiobenthic fauna.
20. **Barthet, Michelle And Mary U. Connell.** Dept. of Biology, Appalachian State University, Boone, NC. 28607. Isolation and initial analysis of the chloroplast DNA from *Scytosiphon lomentaria*.
21. **Robeson, Michael S. And James R. Garey.** Department of Biology, University of South Florida, Tampa, FL 33620. Sequencing the *Brachionus plicatilis* mitochondrial genome.
22. **Conner, Jennifer L., And Ann E. Stapleton.** The University of Tennessee at Chattanooga. Analysis of Maize Proteins that Bind UV Lesions in DNA and the Genes that Encode those Programs.

CYTOLOGY/GENETICS

23. **Stapleton, Ann E., And Heather Cartwright.** University of Tennessee at Chattanooga. How does corn sunburn? Physiological and genetic analysis of responses to ultraviolet radiation.

EVOLUTION

24. **Davis, Carisa And James R. Garey.** Department of Biology, University of South Florida, Tampa, FL 33620. Molecular studies of rotifer evolutionary relationships.
25. **Diehl, Walter J., Cooper, Carlton R., St. Cyr-coats, Karen.** Mississippi State University and University of Michigan - Natural selection in the entire primate lentiviral genome.
26. **Foster, Steven W. And Charles C. Somerville.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - Determining the phylogenetic relationships between the Northern Pike (*Esox lucius*), the Muskellunge (*Esox masquinongy*), and the Silver Pike.
27. **Vu, N. G. And Craig S. Hood.** Dept. Biological Sciences, Loyola University - Fluctuating asymmetry in mandibular form in Louisiana populations of the muskrat, *Ondatra zibethicus*.

ICHTHYOLOGY/HERPETOLOGY

28. **Bonner, Lisa A., Walter J. Diehl, And Ronald Altig.** Dept. Biology, Peace College, Raleigh, NC 27604 and Dept. Biological Sciences, Mississippi State University, Mississippi State, MS 39792 - Reproductive success of amphibian populations in dystrophic forest pools.
29. **Dolin, Robin E., Benjamin M. Lowman, Jason A. Morgan, Ann E. Schoolcraft, And Donald C. Tarter.** - Dept. Biological Sciences, Marshall University, Huntington, WV 25755. - Low pH tolerance of the central mudminnow, *Umbra limi*, from the Green Bottom Wildlife Management Area, West Virginia.
30. **Pauley, Thomas K., Andrew Longenecker, Brian Lindley, Jayme Waldron, And Sandy Raimondo.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - Potential impacts on forest salamanders from multiple applications of insecticides.
31. **O'connell, Ann M. (Uzee) And Paul L. Angermeier.** Gulf Coast Research Laboratory Museum, Ocean Springs, MS 39566 and Virginia Cooperative Fish and Wildlife Research Unit, Virginia Polytechnic Institute and State University, Blacksburg, VA 24060-0321 - Habitat relationships for alewife and blueblack herring in a Virginia stream.

32. **Brzostowski, Lisa And Mark Meade.** Dept. of Biology, Jacksonville State University, Jacksonville, AL 36265 - Phylogenetic relationship among African Cichlids, *Oreochromis spp.*
33. **Menhinick, Edward F. And Anthony J. Roux.** Dept. Biology, University of North Carolina at Charlotte, Charlotte, NC 28223, and Mecklenburg County Department of Environmental Protection, Charlotte, NC 28202. Fishes and water quality of Mecklenburg County.
34. **Menhinick, Edward F. And Steve Clark.** Dept. Biology, University of North Carolina at Charlotte, Charlotte, NC 28223. - Use of Microsoft ACCESS for the computerization of museum records.

INVERTEBRATE ZOOLOGY

35. **Harvey, Margaret C., Gertrude W. Hinsch, And Don F. Cameron.** Dept. of Biology, University of South Florida, Tampa, FL 33620 and Dept. of Anatomy, College of Medicine, University of South Florida, Tampa, FL 33612 - Stage-related changes in the distribution of junction-related cytoskeletal proteins in the crayfish testis.
36. **Menhinick, Edward F. And Margaret M. Schaen.** Dept. Biology, University of North Carolina at Charlotte, Charlotte, NC 28223 - Structure of the gills and the food grooves of freshwater clams.
37. **Foster, Toby, Irene Kokkala, Karen Mcgothin, Kerry Payne And Rowena Harris.** Dept. of Biology, North Georgia College and State University, Dahlonega, GA 30597 and Dept. of Biology, The University of the South, Sewanee, TN 37383 - A preliminary survey of terrestrial tardigrades from Glade Shoals, GA.

MAMMAL BIOLOGY

38. **Cornwell, Kacy, Dennis C. Haney, Stephen J. Walsh, And Elisabeth Gilliard.** Department of Biology, Furman University, Greenville SC 29613 - The influence of salinity and temperature on the physiology of the teleost, *Limia melanotata*.
39. **Rabon, David R., Jr., Wm. David Webster, And D. Kim Sawrey.** Dept. Biological Sciences and Dept. Psychology, University of North Carolina at Wilmington, Wilmington, NC 28403 - Comparison of infant ultrasonic

vocalizations and parental response in the montane vole, *Microtus montanus*, and the prairie vole, *M. ochrogaster*.

40. **Bernstein, Marica And Hal Daniel.** East Carolina University, Greenville, NC - Middle ear anatomy of voles with differing parenting and vocalization behaviors (*Microtus ochrogaster* and *M. pennsylvanicus*).
41. **Conner, Jennifer L., Jaron J. Bergin, And Henry G. Spratt, Jr.** Biodegradation of Waste Crankcase Oil in Laboratory Mesocosms. University of Tennessee at Chattanooga.
42. **Saffore, Lateef Y., And Charles C. Somerville.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - Identification of coliform-like bacteria isolated on eosin methylene blue agar.

PARASITOLOGY

43. **Meacham, John A., Catherine Vogl, Jessica Tolbert, And Patricia Allison.** Biology Department, Catawba College, Salisbury, NC 28144 - Immunostimulatory effects of murine interferon- γ and interleukin-12 on *Schistosoma mansoni*.
44. **O'connell, Martin T. and Richard J. Neves.** University of Southern Mississippi and Virginia Polytechnic Institute and State University - Immunoelectrophoretic analysis of the immunological responses of host and non-host fishes to glochidia and juveniles of a freshwater mussel.

PLANT ECOLOGY

45. **Sheridan, Philip And William Scholl.** Meadowview Research Station, Woodford, VA and Dept. of Biol. Sciences, Old Dominion Univ., Norfolk, VA - *Sarracenia purpurea* L. ssp. *venosa* (Raf.) Wherry var. *burkii* Schnell (green) new to Florida.
46. **Pauley, Eric F., Barbara Dietsch, And Ron E. Chicone, Jr.** Dept. Biology, Coastal Carolina University, Conway, SC 29528 - Survival, growth, and vegetation associations of the threatened *Amaranthus pumilus* (seabeach amaranth) on a South Carolina barrier island.
47. **Stephenson, Steven L., Harold S. Adams, David M. Lawrence, James S. Rentch, Robert B. Coxe, Martin Schnittler, Molly J. Preston And Heather M. Robertson.** Dept. Biology, Fairmont State College, Fairmont,

WV 26554, Div. Arts and Science, Dabney S. Lancaster Community College, Clifton Forge, VA 24422, 9272-G Hanover Crossing Drive, Mechanicsville, VA 23116, Div. Forestry, West Virginia University, Morgantown, WV 26505, and Biota of North America Program, UNC-CH, Chapel Hill, NC 27599 - Forests along the Blue Ridge Parkway south of Roanoke in southwestern Virginia.

48. **Haldeman, Janice h.** Department of Biology, Erskine College, Due West, SC 29639. - Flowering, fruiting, and germination dynamics of Pink Lady Slippers, (*Cypripedium acaule*) in Greenville County, SC.
49. **Morris, Ashley B. and Mitch Cruzan.** Dept. of Botany, University of Tennessee, Knoxville, TN - Genetic variation in the *Fagus grandifolia* complex.
50. **Suchecki, Paul F. And Philip A. Robertson.** Dept. Plant Biology, Southern Illinois University at Carbondale - Vegetation analysis and succession at LaRue Pine Hills Research Natural Area, Union County, Illinois.
51. **James, Mary M.** Curriculum in Ecology, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599-3275 - Patterns of legume distribution in the Carolina sandhill.
52. **Dilustro, John J. And Frank P. Day.** Old Dominion University, Norfolk, VA 23529 - Substrate and microenvironmental effects of elevated carbon dioxide on root decomposition.
53. **Cooper, Aaron, Larissa Knebel, And J. Dan Pittillo.** Department of Biology, Western Carolina University. A predictive model of the changes in herbaceous cover in hemlock forests of the Great Smoky Mountains National Park.
54. **Webbeking, Amy L. And Scott B. Franklin.** University of Memphis, Memphis, TN 38152 - Vegetative Re-growth of Kudzu Pond following Transline Herbicidal Treatment of *Pueraria montana*.
55. **Rodgers, H. Leroy And Frank P. Day.** Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529 - A comparison of fine root dynamics in naturally-recovering and restored Atlantic white cedar swamps.
56. **Thompson, Ralph L., Chris A. Fleming, Amanda N. Allen, W. Neal Denton, And Johnny R. Skeese.** Biology Department, Berea College,

Berea, KY 40404, Plant and Soil Science Department, University of Tennessee, Knoxville, TN 37950 and Pharmacy Department, University of Toledo, Toledo, OH 43606 - Vascular flora and plant communities of The John B. Stephenson Memorial Forest State Nature Preserve, Rockcastle County, Kentucky Vascular flora and plant communities of The John B. Stephenson Memorial Forest State Nature Preserve, Rockcastle County, Kentucky.

57. **Schening, Michael R. And Cliff Hupp.** U.S. Geological Survey, Reston, VA 20192 - Landform attributes, soil moisture and forest composition in the Central Appalachians.
58. **Madsen, Dana L. And Joan L. Walker.** USDA Forest Service, Clemson, SC - Effects of time since fire and site on seed produciton in *Macbridea alba*, a rare mint.
59. **Mckenna, Mary, Corey Palmer, Deadrea Fontaine And Andrea Woods.** Department of Biology, Howard University, Washington, DC 20059 - Variation in pollen response to pH: Does it reflect differences in the acidity of the environment.
60. **Friece, Monica P. And Eric F. Pauley.** Dept. Marine Science and Dept. Biology, Coastal Carolina University, Conway, SC 29528. Effects of low salinities and soil types on germination and growth of *Sapium sebiferum* (Chinese tallow) seedlings.
61. **Langley, Susan K. And Cecil C. Frost.** Dept. Botany, North Carolina State University, Raleigh, NC 27695-7612 and North Carolina Plant Conservation Program, P. O. Box 27647, Raleigh, NC 27611 - Mapping fire compartments using a geographic information system.
62. **Berry, Monica L., Joe A. Ellington, Pat J. English, Calvin L. McCullough, John E. Mitchell, Martin L. Mitchell, And Sherri L. Defauw.** Dept. Biological Sciences and Div. Computer Information Systems, Delta State University, Cleveland, MS 38733 - Landscape transitions on Dahomey N.W.R., Bolivar County, Mississippi.

PLANT PHYSIOLOGY

63. **Miller Iii, Hugh A., Greg Hemontoler, Eric Bowman, Michael Owston, And Leslie Brown.** East Tennessee State University, Johnson City, TN 37614. Plant Natriuretic Peptide (PNP): Water Stress Response is Abscissic Acid Dependent.
64. **Holt, Terri, Marcia Harrison, And Jagan Valluri.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755. - Characterization of molecular responses in gravistimulated pea stems.

TEACHING BIOLOGY

65. **Estill, James, Mark Camara, Mitch Cruzan And Ken McFarland.** University of Tennessee, Knoxville - A survey of World Wide Web Use by students in Introductory Botany and General Ecology at the University of Tennessee, Knoxville.
66. **Jagan V. Valluri And H. W. Elmore,** Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - BandAnalyzer: software for determination of protein Rf values and calculation of molecular weight.
67. **Mathis, Marilyn J., Beth A. Middleton, David J. Gibson, And Andrew T. Lumpe.** Dept. of Plant Biology, Southern Illinois University, Carbondale, IL 62901 - Long-term succession for undergraduate education and research.

Thursday, 15 April 1999

Paper Sessions

SABS/ASB Symposium - Magnolia Room, Hilton

Southeastern Endemics: Speciation and Biogeography

Presiding: Dr. Zack Murrell, Appalachian State University

- 8:00 **Rogers McVaugh.** University of North Carolina at Chapel Hill. Botanical research in the southeast. NO ABSTRACT - the symposium is dedicated to the academic career of Dr. McVaugh

- 8:30 68. **Cruzan, Mitch and James C. Estill.** University of Tennessee-Knoxville. Genetic diversity in endemic species: assessing the roles of historical and contemporary processes.
- 9:00 69. **Werth, Charles R., Warren H. Wagner, Jr., Florence S. Wagner and A. Murray Evans.** Texas Technological State University, University of Michigan, and University of Tennessee-Knoxville. Allopatry, allopolyploidy, dispersal and endemism: Origin of the pteridophyte species in the temperate southeastern United States.
- 9:30 **70. **Anders, Constance M., Nicholas Drozda, Alex Plocik, and Zack Murrell.** Western Kentucky University and Appalachian State University. Biogeographical implications of variation in *Spirea virginiana*.
- 10:00**71. **McCartney, Elizabeth A., Jeri W. Higginbotham, and R. David Whetstone.** Jacksonville State University and Transylvania University. Conservation biology of *Sagittaria secundiflora* (Alismataceae).
- 10:30**72. **Welch, Nicole There'll and Thomas A. Waldrop.** Indiana University and USDA Forest Service Southern Research Station. Restoring *Pinus pungens* communities with prescribed fires: theory and practical application.

COASTAL ENDEMICS

- 11:00 73. **Sorrie, Bruce A. and Alan S. Weakley.** Independent consultant and Southeastern Region Office of The Nature Conservancy. Coastal Plant Endemics: phytogeographic patterns.

LUNCH

- 1:00 74. **LeBlond, Richard.** North Carolina Heritage Program. Investigation of geological and ecological conditions associated with plant endemism in the Cape Fear Arch region of North and South Carolina.
- 1:30 75. **Menges, Eric S., Rebecca W. Dolan, Rebecca Yahr, and Doria R. Gordon.** Archbold Biological Station, Butler University, Duke University, and The Nature Conservancy and the University of Florida. Comparative genetics of seven plants endemic to Florida's Lake Wales Ridge.

- 2:00 76. **Lacey, Elizabeth, Alejandro Royo, Ramona Bates, and David Herr.** University of North Carolina at Greensboro. The role of matrix models in biogeographic plant species: evidence from a study of *Lobelia boykinii*, a rare plant species endemic to the Carolina Bays.

OUTCROP ENDEMICS

- 2:30 77. **Allison, James R. and Timothy E. Stevens.** Georgia Department of Natural Resources and Alabama Department of Public Health Laboratories. Endemic flora of the Ketona Dolomite Glades of Alabama
- 3:00 78. **Baskauf, Carol J.** Austin Peay State University. Examining rarity through comparisons with widespread congeners: a genetic and ecophysiological example from limestone glade endemics.
- 3:30 79. **Levy, Foster and Kimberly A. Malone.** East Tennessee State University. *Phacelia dubia* in South Carolina, a key step in the pathway to endemism.
- 4:00 80. **Murdy, William H. and M. Eloise Brown Carter.** Oxford College of Emory University. Speciation in *Talinum* in the Southeast.
- 4:30 81. **Mellinger, Claire.** Eastern Mennonite University. Ecological life cycle of *Viguiera porteri*: (Asteraceae) and factors responsible for its endemism to granite outcrops of Georgia and Alabama.

Thursday, 15 April 1999

**Workshop "Introductory Biology:
Curriculum or Laboratory"**

**Sponsored by the
ASB Committee on Education**

Convention Center Room A

Presiding: Dr. Robert George - UNC Wilmington

- 8-10:30 82. Speaker : Dr. Steven Vogel, Duke University. The Last Word about All of Biology

Thursday, 15 April 1999

**Workshop sponsored by ASB Committee on Women,
Minorities and the Disabled, and the ESA/SE Chapters.**

Convention Center Room A

Presiding: Dr. Hank Bart - Tulane Museum of Natural History

10:30-1 PM National Science Foundation presenters will talk about programs for increasing participation of Women, minorities and the Disabled in the sciences. **All ASB members are welcome.**

Presenters: Dr. Margaritte S. Klein
Dr. Costello Brown

Snacks and refreshments will be provided at the end of the presentations.

Thursday, 15 April 1999

Paper Sessions

Microbiology and Parasitology Convention Center Room A

Presiding: Dr. Lafayette Franklin, Howard University

- 1:00 83. **Spratt, Henry G., Jr., Kristen B. Howerton, and Nicholas E. Dobosh.** The University of Tennessee at Chattanooga - The effects of clear-cutting and selective harvest of timber on carbon, sulfur and nitrogen transformations in surface soils of a Missouri Ozark forest
- 1:15 84. **Ressler, Debra A., Henry G. Spratt, Jr., and Ann E. Stapleton.** The University of Tennessee at Chattanooga - Effects of UV Radiation on the Degradation Capabilities of Two Strains of Oil Degrading Bacteria
- 1:30 85. **Howerton, Kristen B. and Henry G. Spratt, Jr.** The University of Tennessee at Chattanooga - Determination of lignocellulose and herbicide degradation rates by forest soil microorganisms in relation to herbicide exposure

- 1:45 86. **Burdette, Jill E., and Henry G. Spratt, Jr.** University of Tennessee at Chattanooga, TN 37403 - Determination of microbial biomass in surface soils of the Tennessee River Gorge.
- 2:00 87. **Al-Dujaili, Jameel and Michael Fontenot**, Louisiana State University at Eunice. Assessment of drinking water quality in the southwest Louisiana community area.
- 2:15 88. **Benjamin, Ebony, Gerod Hall, Ann C. Williams and L. Frederick.** Howard University. Electrophoresis studies on culture filtrates of *Bacillus* sp. with anti-fungal properties.
- 2:30 89. **Livingston, M. R. and L. L. Lundie, Jr.** Appalachian State University, Boone NC - Isolation and partial characterization of a sulfidogen capable of growth on *n*-hexadecane as the sole carbon
- 2:45 90. **Frederick, L., Ebony Benjamin, Gerod Hall and W. Lena Austin.** Howard University, Washington, DC - Studies on a *Bacillus* species that produces substances antagonistic to fungi.
- 3:00 **Break**
- 3:30 91. **Frederick, L. and Dillon T. Chen.** Howard University, Washington, DC. Effect of antifungal substances produced by *Bacillus* sp. on growth and pathogenicity of *Ophiostoma ulmi*.
- 3:45 **92. **Blair, Benjie G. and Kevin L. Anderson.** Jacksonville State University and Mississippi State University. Regulation of Cellulose Affinity Proteins of *Eubacterium cellulosolvens* 5494 and *Clostridium cellulovorans* 743B.
- 4:00 93. **Bradbury, Alyce and James Joy.** Dept. Biological Sciences, Marshall University, Huntington, WV 25701. A comparison of parasitic species from basses in both river and lake ecosystems.
- 4:15 94. **Bickford, Nate and R. N. Henson,** Appalachian State University. Survey of gastrointestinal helminths of small mammals in Watauga County, N.C., and variations in frequency and distribution due to host location, host species, and time of year.

Invertebrate Biology Convention Center Room B

Presiding: Dr. Geraldine Twitty, Howard University

- 8:00 95. **Rogers, Susan O. and Richard J. Neves.** Virginia Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061. Use of freshwater mussel propagation to aid recovery of endangered species populations.
- 8:15 96. **Eskew, Kelly R., Robert R. Mangino, and Frank S. Corotto.** Dept. Biology, North Georgia College and State University, Dahlonega, GA 30597 and Dacula High School, Dacula, GA 30211. Role of vision in sex identification of *Procambarus clarkii*.
- 8:30 97. **Nichols, Phillip B., Frank A. Romano, III, and Diane R. Nelson.** Dept. of Biology, Jacksonville State University, Jacksonville, AL and Dept. of Biological Sciences, East Tennessee State University, Johnson City, TN - A Distributional Survey of Terrestrial Tardigrades of Dugger Mountain, Alabama.
- 8:45 98. **Romano, Frank A.** Dept. of Biology, Jacksonville State University, Jacksonville, AL. Tardigrades from the campus of Jacksonville State University.
- 9:00 99. **Barreras, Blanca E., Frank A. Romano, III, and Diane R. Nelson.** Dept. of Biology, Jacksonville State University, Jacksonville, AL and Dept. of Biological Sciences, East Tennessee State University, Johnson City, TN - A Distributional Survey of Riparian Zone Tardigrada of Choccolocco Creek, Alabama.
- 9:15 100. **Gaugler, Michael and Diane Nelson.** East Tennessee State University. Marine interstitial tardigrades of Huntington Beach State Park, South Carolina
- 9:30 101. **Karriker, Laura and Edward F. Menhinick.** Dept. Biology, University of North Carolina at Charlotte, NC 28223. Gill transfer of food by freshwater mussels.
- 9:45 102. **Johnson, Jason W. and Stephen C. Landers.** Dept. Biological Sciences, Troy State University. Food plaque digestion and elimination in the ciliated protozoan *Hyalophysa chattoni*.

HERPETOLOGY - Session 1 Convention Center Room B

Presiding: Dr. George Cline, Jacksonville State University

- 10:30 103. **Greene, Judith L., J. Whitfield Gibbons and Nat B. Frazer.** Savannah River Ecology Laboratory, University of Georgia, Aiken, SC 29802. The common snapper, *Chelydra serpentina*, in southeastern wetlands.
- 10:45 104. **McCartney, Gavin A., George R. Cline, and Roger Sauterer.** Jacksonville State University, Jacksonville, AL - Population Genetics of the Gray Treefrog, *Hyla chrysoscelis*: Genetic Similarity Among Proximal and Distal Sites.
- 11:00 105. **Mohr, Jeffrey R. and Michael Dorcas.** Savannah River Ecology Laboratory. Department of Biology, Furman University, Greenville, SC 29613 and Department of Biology, Davidson College, Davidson NC 28036. A Comparison of Anuran Calling Pattern at Two Carolina Bays in South Carolina.
- 11:15 106. **Adams, Jason and George R. Cline.** Jacksonville State University, Jacksonville, AL. Similarity analysis of amphibian calling communities.
- 11:30 107. **Couch, James and George R. Cline.** Jacksonville State University. Seasonal and Diel Calling Patterns in Three Northeastern Alabama Anuran Communities.

HERPETOLOGY Session 2 Convention Center Room B

Presiding: Whit Gibbons, Savannah River Laboratory

- 1:00 108. **Lindley, Brian and Thomas K. Pauley.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - Study of the natural history for the northern spring salamander *Gyrinophilus porphyriticus porphyriticus* at the Westvaco Wildlife and Ecosystem Research Forest in Randolph County, West Virginia.
- 1:15 109. **Spanovich, Stacey.** Appalachian State University. Energy allocation in Three Lizard Species during Tail Regeneration.

- 1:30 110. **Humphries, W. Jeffrey and Thomas K. Pauley.** Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. Population demography and habitat utilization of the eastern hellbender, *Cryptobranchus a. alleganiensis*, in Pocahontas County, West Virginia.
- 1:45 111. **Pauley, Beth Anne and Thomas K. Pauley.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755. The association of *Plethodon nettingi* with emergent rocks.
- 2:00 112. **Raimondo, Sandra and Thomas K. Pauley.** Marshall University, Huntington, WV 25755. Potential shifts in salamander diets as indirect effects of gypsy moths pesticides.
- 2:15 113. **Camper, Jeffrey D.** Dept. of Biology, Frances Marion University, Florence, SC 29501-0547. Forest management practices and herpetofaunal diversity in the South Carolina sandhills.
- 2:30 114. **Pauley, Thomas K., and Joseph C. Mitchell.** Dept. Biological Sciences, Marshall, WV 35755 and Allegheny Institute of Natural History, University of Pittsburgh at Bradford; Dept. of Biology, University of Richmond, Richmond, VA 23173 - Potential Effects of Silvicultural Practices and Deer Densities on Forest Salamanders in Northwestern Pennsylvania
- 2:45 115. **Beck, Michelle L., Matthew P. Rowe, and R. Wayne Van Devender.** Dept. of Biology, Appalachian State University, Boone, NC 28608. Defensive escalation in vipers: the effects of ecdysis and feeding.
- 3:00 116. **Carter, Jacqueline, and George R. Cline.** Jacksonville State University, Jacksonville. AL. Sexual Dimorphism in Four Subspecies of the Box Turtle, *Terrepene carolina*.

Teaching Biology Convention Center Room B

Presiding: Dr. Robert McGuire, University of Montevallo

- 4:00 117. **Shull, J. Kenneth, Jr.** Appalachian State University. Unexpected indicators of success in biology.

- 4:15 118. **Weigant, Patricia L.** Peace College - A critical thinking laboratory exercise in an undergraduate ecology course: using an Excel spreadsheet to model calcium nutrient cycle in a prairie ecosystem.
- 4:30 119. **Sauterer, Roger A.** Jacksonville State University, Jacksonville, AL - Exobiology courses: A vehicle for demonstrating connections between biology and the other sciences.
- 4:45 120. **Durrant, Gary.** Department of Biology, Jacksonville State University, Jacksonville, AL - Using Arc/View GIS Software in Biological Education.
- 5:00 121. **McGuire, Robert F.** University of Montevallo - Applying algebra to genetic exercises.

Aquatic Wetlands/Ecology, Session 1 Convention Center Room C

Presiding: Dr. Barbara Raffail, Georgetown College

- 8:00 122. **Hooker, Valerie E. and Terry D. Richardson.** Department of Biology, University of North Alabama, Florence AL 35632-0001 - A life history comparison of *Viviparus georgianus* found in a temporary riparian wetland and a permanent stream.
- 8:15 123. **Justice, Greg, Luther Brown and Susan Elliott.** Center for Field Studies, New Century College, George Mason University, Fairfax, VA 22030 - An analysis of beach debris from Andros Island, Commonwealth of the Bahamas.
- 8:30 124. **Dohogne, Molli, Kristina Jones, and Luther Brown.** Center for Field Studies, New Century College, George Mason University, Fairfax, VA 22030 - A vertical profile of a freshwater blue hole on Andros Island, Commonwealth of The Bahamas.
- 8:45 125. **Hanlon, Shane and Richard Neves.** Virginia Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061 - Comparison of survival in juvenile mussels (*Lampsilis fasciola*) released into a fish hatchery raceway.

- 9:00 126. **Spicer, Jennifer S. and Eric F. Pauley.** Dept. Biology, Coastal Carolina University, Conway, SC 29528 - Microtopography and cover crop effects on vegetative colonization of a created wetland.
- 9:15 127. **Gray, Margarit.** Erskine College and Clemson University - Employing the Algal Growth Potential Test to determine the effect of *Corbicula fluminea* on an aquatic ecosystem.

Ichthyology Session 1 Convention Center Room C

Presiding: Dr. Stephen Ross, University Southern Mississippi

- 9:30 128. **Newman, Marie C. and Eugene C. Maurakis.** Hampden Sydney College, VA 23943 and Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220 and University of Richmond, VA 23173 - Breeding behaviors in *Notropis alborus*.
- 9:45 129. **Barmore, Jonathan G., David C. Heins, and Frank Jordan.** Department of Ecology, Evolution and Organismal Biology, Tulane University, New Orleans, LA 70118 and Department of Biological Sciences, Loyola University, New Orleans, LA 70118 - Comparative behavior of two potentially competing stream fishes.
- 10:00 **BREAK**
- 10:30 130. **Nelson, Diane R.** East Tennessee State University - Observations of nesting triggerfish and burrowing blennies in the Solomon Islands
- 10:45 131. **Gamble, Robert J. and David G. Lindquist.** University of North Carolina at Wilmington - Distribution of larval fishes in Onslow Bay, NC: A comparison of catches in shelf water and Gulf Stream water.
- 11:00 132. **Tzeng, Mimi W., Jonathan A. Hare, Allyn B. Powell and David G. Lindquist.** University of North Carolina at Wilmington and NOAA Beaufort Laboratory - Ingress of postlarval snappers (principally *Lutjanus griseus*) into the Newport River Estuary, North Carolina.
- 11:15 133. **Woodson, Heather W. and Ileana E. Clavijo.** Dept. of Biological Sciences and Center for Marine Sciences Research, University of North Carolina, Wilmington, NC 28403-3297 - Diet of coastal pelagic fishes in North Carolina: Predators of newly hatched loggerhead turtles?

Ichthyology Session 2 Convention Center Room C

Presiding: Dr. Eugene Maurakis, Science Museum of Virginia

- 1:00 134. **Heins, David C. and John A. Baker.** Dept. Ecology, Evolution and Organismal Biology, Tulane University and Department of Biology, Clark University - Evaluation of ovum storage techniques for reproductive studies of fishes.
- 1:15 135. **Hood, Craig S. and David C. Heins.** Dept. Biological Sciences, Loyola University and Dept. Ecology, Evolution, and Organismal Biology, Tulane University - Ontogeny and allometry of body shape in the blacktail shiner, *Cyprinella venusta*.
- 1:30 136. **Guill, J. Michael, David C. Heins, and Craig S. Hood.** Department of Ecology, Evolution, and Organismal Biology, Tulane University, New Orleans, LA 70118 - Female body shape variation within and among three species of darters.
- 1:45 137. **Goodin, John T., Eugene G. Maurakis, Elgin S. Perry and William S. Woolcott.** Wetlands Div. EPA, 401 M St., SW, Washington, DC 20460, Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220 and Biology Dept., University of Richmond, VA 23173, and 2000 Kings Landing Rd., Huntingtown, MD 20639 - Species recognition for *Percina nevisense* Cope.
- 2:00 138. **Jackson, Nakia C., Rheneisha E. Mable, and Henry L. Bart Jr.** - Ecology, Evolution and Organismal Biology, Dept., Tulane University, New Orleans, LA 70118 - Fin proportion differences in populations of *Cyprinella venusta* (Osteichthyes: Cyprinidae) from different stream runoff regimes.
- 2:15 139. **Herbst, Eric C. and Edward F. Menhinick.** Dept. Biology, University of North Carolina at Charlotte, Charlotte, NC 28223. A computerized polyclave for fish identification.
- 2:30 140. **Burse, Jeanine R., Ann O. Cheek, and Henry L. Bart, Jr.** Ecology, Evolution and Organismal Biology Dept., Tulane University, New Orleans, LA 70118 and Dept. of Biology, Southeastern University of Louisiana, Hammond, LA 70402 - Immunohistochemical detection of Vitellogenin (Vg) in formalin-fixed livers of *Lepomis macrochirus*.

- 2:45 141. **Gladden, John and Mark Meade.** Department of Biology, Jacksonville State University, Jacksonville, AL 36265 - Biochemical identification of channel catfish *Ictalurus punctatus*, blue catfish *Ictalurus furcatus*, and their hybrid

3:00 **BREAK**

- 3:30 142. **Johnson, Jill M. and David C. Heins.** Dept. of Ecology, Evolution and Organismal Biology, Tulane University, New Orleans, LA 70118 - Reproductive biology of the nine spine stickleback, *Pungitius pungitius*, from South-central Alaska.

- 3:45 143. **Howard, Gregory G. and Werner Wieland.** Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401 - Occurrence of *Theostoma fusiforme* in the York River basin of Virginia.

4:00-4:30 ASI-H-SE Business Meeting - Convention Center Room C

4:30-5:30 Southeast Fisheries Council Meeting - Convention Center Room C

Aquatic Ecology - Session 1 Convention Center Room D

Presiding: Dr. Irene Kokkala, University of North Georgia

- 8:00 144. **Hughes, Melany, Raymond L. Petersen, and Richard M. Duffield.** Dept. Biology, Howard University, Washington, DC 20059 - *Plethodon cinereus* (Red-backed Salamander) trapped in leaves of the Purple Pitcher Plant, *Sarracenia purpurea* L.
- 8:15 145. **Poppy, Sean M., Michael E. Dorcas, and J. Whitfield Gibbons.** Savannah River Ecology Laboratory and Dept. of Biology, Davidson College - Population estimate of the black swamp snake (*Seminatrix pygaea*) at a Carolina bay.
- 8:30 146. **Ryan, Travis J., and Raymond D. Semlitsch.** Savannah River Ecology Laboratory, Drawer E, Aiken SC 29802 and Division of Biological Sciences, University of Missouri, Columbia MO 65211 - Growth, metamorphosis and maturation in a salamander (*Ambystoma talpoideum*) with a life cycle polymorphism.

- 8:45 147. **Bockoven, Beth.** Western Carolina University. Peregrine falcon restoration in the southern Appalachians.
- 9:00 148. **Leiden, Yale A., M. E. Dorcas, J. W. Gibbons.** Savannah River Ecology Laboratory, Davidson College - Herpetofaunal biodiversity in a Coastal Plain community: Landscape-level ecological research in Marion County, South Carolina.
- 9:15 149. **Barry, Ronald E. and Peter J. Mundy.** Dept. of Biology, Frostburg State University, Frostburg, MD 21532 and Department of National Parks and Wildlife Management, P. O. Box 2283, Bulawayo, Zimbabwe. Population dynamics of two species of hyrax in Matobo National Park, Zimbabwe.
- 9:30 150. **Sucke, Alana C. and Ronald E. Barry.** Dept. of Biology, Frostburg State University, Frostburg, MD 21532 - Density, survival, and winter diet of the Appalachian cottontail, *Sylvilagus obscurus*, in the Monongahela National Forest, West Virginia.
- 9:45 151. **Schwartz, F. J.** Institute of Marine Sciences, University of North Carolina, Morehead City, NC - Fishes of North Carolina affected by freshwater inflows or marine intrusions.
- 10:00 **BREAK**
- 10:30 152. **Boyce, Kelly A. and Ronald E. Barry.** Dept. of Biology, Frostburg State University, Frostburg, MD 21532 - Habitat, thermal cover, and home range of the Appalachian cottontail, *Sylvilagus obscurus*, at Dolly Sods, West Virginia.
- 10:45 153. **Jones, Tom and William Pearson.** Division of Natural Sciences, Alderson-Broaddus College, Philippi, WV 26416 and Dept. Biology, University of Louisville, Louisville, KY 25226 - Predator/prey interactions among aquatic, troglobitic organisms from Mammoth Cave National Park.
- 11:00 154. **Hancock, Tim, Sean Loudin, Tom Jones and William Pearson.** Division of Natural Sciences, Alderson-Broaddus College, Philippi, WV 26416 and Dept. Biology, University of Louisville, Louisville, KY - Temporal and spatial variation in reproduction of aquatic, troglobitic organisms from Mammoth Cave National Park.

Plant Ecology - Session 1 Convention Center Room D

Presiding: Dr. Stewart Ware, William and Mary College

- 12:45 155. **Hupp, Cliff R., Robert K. Peet, and Phillip A. Townsend.** U.S. Geological Survey, Reston, VA. University of North Carolina, Chapel Hill, NC and University of Maryland, Appalachian Laboratory, Frostburg, MD - Fluvial Geomorphic Trends in the Bottomland Hardwood Forests of the lower Roanoke River, North Carolina.
- 1:00 156. **Bagga, Davinderjit K.** University of Montevallo - Phytoremediation of soil and water contaminated with hazardous chemicals.
- 1:15 157. **Sharma, G. K.** Dept. Biological Sciences, University of Tennessee, Martin, TN 38238 - Morphological and cuticular variations in *Cannabis sativa*.
- 1:30 158. **Stalter, Richard.** Dept. Biological Sciences, St. John's University, Jamaica, NY 11439 - The vascular flora of Ellis Island, New York.
- 1:45 159. **Peet, Robert K.** Department of Biology, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599-3280 - Longleaf pine vegetation of the Carolinas and adjacent Georgia.
- 2:00 160. **Boetsch, John R., Frank T. Van Manen, and Joseph D. Clark.** Dept. of Biology, University of North Carolina, Chapel Hill, NC 27599-3280 and Dept. of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, TN 37901-1071 - Modeling the geographic distribution of a rare plant, *Cardamine clematitis*: a case study in Great Smoky Mountains N.P.
- 2:15 161. **Muth, Christine C. and Jason B. West.** Department of Organismic & Evolutionary Biology, Harvard University, Cambridge, MA 02138 and Department of Botany, University of Georgia, Athens, GA 30602 - Microenvironmental variation between understory patch types in a longleaf pine ecosystem.
- 2:30 162. **Basinger, Mark A. and Jody P. Shimp.** Southern Illinois University, Carbondale, IL 62901 and Department of Natural Resources, Golconda, IL 62938. Status of *Silene ovata* Pursh in the eastern United States, with particular reference to Illinois.

- 2:45 163. **Kartesz, John T. and Robert B. Coxe.** Biota of North America Program, CB #3280 Coker Hall, UNC-Chapel Hill, Chapel Hill, NC 27599 - A Visual Polyclave Computer Key for the North American Flora.

3:00 **BREAK**

Plant Ecology - Session 2 Convention Center Room D

Presiding: Dr. Howard Neufeld, Appalachian State University

- 3:30 164. **Brubaker, Daniel A. and James J. Wallace.** Department of Biology, Western Carolina University, NC 28723 - Flavanoid Identification within Hymenophyllaceae: *Macroglena*.
- 3:45 165. **Neufeld, Howard S., E. Henry Lee, James R. Renfro, Songqiao Huang, and W. David Hacker.** Dept. of Biology, Appalachian State University, Boone, NC, U.S. EPA, Corvallis, OR, Great Smoky Mountains National Park, Gatlinburg, TN, Dept. of Biology, Los Angeles Community College, Los Angeles, CA, and Dept. of Environmental Manager, New Mexico Highlands University, Las Vegas, NM - Insensitivity of several conifer species to ozone in Great Smoky Mountains National Park.
- 4:00 166. **Basinger, Mark A. and Philip A. Robertson.** Southern Illinois University, Carbondale, IL 62901. Effect of beaver (*Castor canadensis*) on vegetation composition in a wet-floodplain forest at Horseshoe Lake Conservation Area, Alexander County, Illinois.
- 4:15 167. **Rentch, James S., Harold S. Adams, Robert B. Coxe, and Steven L. Stephenson.** Div. of Forestry, West Virginia Univ., Morgantown, WV 26506, Div. of Arts and Sciences, Dabney S. Lancaster Community College, Clifton Forge, VA 24422, Robert J. Goldstein & Associates, Inc., Raleigh, NC 27616, Dept. of Biology, Fairmont State College, Fairmont, WV 26554 - An ecological study of a Carolina hemlock (*Tsuga caroliniana*) community in southwestern Virginia.
- 4:30 168. **McMullen, Conley K.** Dept. of Biology, MSC 7801, James Madison University, Harrisonburg, VA 22807 - Reproductive biology of three Galapagos Islands angiosperms with an emphasis on nocturnal pollination.

- 4:45 169. **Pittillo, J. Dan, Larissa Knebel, and Aaron Cooper.** Department of Biology, Western Carolina University, Cullowhee, NC 28723. Eastern hemlock (*Tsuga canadensis*) old-growth communities of Cataloochee watershed, Great Smoky Mountains National Park.
- 5:00 170. **Brown, C. Michelle, Howard S. Neufeld and Ray S. Williams.** Department of Biology, Appalachian State University, Boone, NC - Herbivory patterns in *Rhododendron maximum*, a broad-leaved evergreen shrub of the southern Appalachian mountains.
- 5:15 171. **McKerrow, Alexa J. and Steven G. Williams.** NC Gap Analysis Project, North Carolina State University, Raleigh, NC 27695-7106 0- An Overview of the North Carolina Gap Analysis Project.

FRIDAY, 16 APRIL 1999

Coastal Ecology Symposium - Hilton Hotel Magnolia Room

Presiding: *Drs. Michael J. Durako and Robert Y. George*

Purpose: To present a series of selected review papers on aspects of coastal ecology of the southeastern United States, with emphasis on biodiversity, biogeography, and conservation

- 8:30 Welcome and introduction to symposium
- 8:40 172. **Kruczynski, Bill.** U.S. Environmental Protection Agency. Plant communities at the land/sea interface: Why do we need to protect them?
- 9:00 173. **Durako, Michael.** University of North Carolina at Wilmington. Changes in sea grass distribution and diversity: Is this a good thing?
- 9:20 174. **Vargo, Gabe.** University of South Florida. Coastal phytoplankton blooms: What are they telling us?
- 9:40 175. **Ogden, John.** Florida Institute of Oceanography. Coral reef conservation: What are the global and regional issues?
- 10:00 **BREAK**

- 10:15 176. **George, Robert Y.** University of North Carolina at Wilmington. Biological impact of the Gulf Stream on coastal marine ecosystems: Are there seasonal and climatological signatures?
- 10:35 177. **Poss, Stuart.** Gulf Coast Research Laboratory. Coastal fish distribution and diversity in the S.E. U.S.: Is it changing?
- 10:55 178. **Webster, David.** University of North Carolina at Wilmington. Sea turtle distribution and breeding along the southeastern coast: Can we maintain our populations?
- 11:15 179. **Hodson, Ron.** NC Sea Grant. Potentials for aquiculture along the coast: A North Carolina example.

Aquatic/Wetland Ecology Hilton Hotel - Magnolia Room

Presiding: Dr. Donald Tarter, Marshall University

- 1:00 180. **Barnett, K. G., Michael L. Little, and Donald C. Tarter.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - Preliminary observations on the isozyme patterns and morphometrics of *Gambusia* sp. in the Green Bottom Wildlife Management Area, West Virginia.
- 1:15 181. **Wykle, Jennifer and Donald C. Tarter.** Dept. Biological Sciences, Marshall University, Huntington WV 25755 - Range extensions and low pH tolerances of the amphipods *Crangonyx rivularis* and *C. richmondensis richmondensis* from the Meadow River wetland complex, West Virginia.
- 1:30 182. **Wooten, Matthew S., Erich B. Emery and Donald C. Tarter.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755 and Ohio River Valley Water Sanitation Commission, Cincinnati, OH 45228 - Selection of reference sites and testing of candidate metrics for a macroinvertebrate index on the Ohio River.
- 1:45 183. **Rose, Tara L., Erich B. Emery, and Donald C. Tarter.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755 and Ohio River Valley Water Sanitation Commission, Cincinnati, OH 45228 - Distribution of the sucker family (Pisces: Catostomidae) in the Ohio River.

- 2:00 184. **Aderman, Jennifer and Donald C. Tarter.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - Life history and ecology of the freshwater prawn, *Palaemonetes kadiakensis*, in a mitigated wetland of the Green Bottom Wildlife Area, West Virginia.
- 2:15 185. **Morgan, Jason A., Janet L. Clayton, and Donald C. Tarter.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755 and West Virginia Division of Natural Resources, Elkins WV 26241 - Food habits of *Salmo trutta* and *Salvelinus fontinalis* (Pisces: Salmonidae) in relation to age, season, and mitigative liming effects in Dogway Fork, West Virginia.
- 2:30 186. **Lowman, Ben M., Erich B. Emery, Donald C. Tarter.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755 and Ohio River Valley Water Sanitation Commission, Cincinnati, OH 45228 - Changes among Ohio River fish populations due to ecological and reproductive conditions created by high-lift dams.
- 2:45 187. **Tomasek, Terry and Donald Tarter.** Dept. Biological Sciences, Marshall University, Huntington, WV 25722 - Preliminary results on the long-term impacts of multiple seam contour mining and valley fill on water quality and benthic macroinvertebrates in a West Virginia stream.
- 3:00 **BREAK**
- 3:30 188. **Ginger, Jeffrey V., Donald C. Tarter, Bret A. Preston and Erich B. Emery.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755, West Virginia Division of Natural Resources, Charleston, WV and Ohio River Valley Water Sanitation Commission, Cincinnati, OH 45228 - The relationship between Ohio River bass tournament success rates, forage fish abundance, and environmental conditions.
- 3:45 189. **Thompson, Althea and Safaa Al-Hamdani.** Department of Biology, Jacksonville State University, Jacksonville, AL 36265. Salinity Influence on Selected Physiological Responses in *Salvinia minima*.
- 4:00 190. **Bone, Samantha and Safaa Al-Hamdani.** Department of Biology, Jacksonville State University, Jacksonville, AL 36265 - Independent Influence of Light and Temperature on *Salvinia minima* Growth, CO₂ Assimilation, and Photosynthetic Pigments.

- 4:15 191. **Winstead, Joe E.** Dept. Biological and Environmental Sciences, Morehead State University, Morehead, KY 40351 - Growth rate and reproductive patterns in *Polygonum cuspidatum*.
- 4:30 192. **Helms, Brian S. and Robert P. Creed, Jr.** Appalachian State University - The effects of coexisting crayfish on sediment accumulation in an Appalachian river.
- 4:45 193. **Martin, Shannon B., Ronald Sicard, and Gary P. Shaffer.** Dept. of Biological Sciences, Southeastern Louisiana University, Hammond, LA 70402 - A greenhouse study to determine the effects of saltwater intrusion, flood regime, and substrate type on three species of *Sagittaria*.
- 5:00 194. **Desroches, Dennis J., Gary P. Shaffer, and Mark W. Hester.** Southeastern Louisiana University - Restored drill cuttings: A mesocosm approach to determine the suitability as a substrate for wetlands restoration and creation.
- 5:15 195. **Souther, Rebecca F., Gary P. Shaffer, and Frank Campo.** Dept. of Biological Sciences, Southeastern Louisiana University, Hammond, LA 70402 - The effects of variable levels of submergence and light on two age classes of baldcypress (*Taxodium distichum* (L.) Richard) seedlings.

Plant Physiology Hilton Hotel - Dogwood Room

Presiding: Dr. Lyton Musselman, Old Dominion University

- 1:00 196. **Sandhu, Ravinder and Brenda Bobo.** Troy State University, Troy, AL 36082 - Effects of ambient ultraviolet radiation (UV-A and UV-B) on growth of cucumber plants.
- 1:15 197. **Marshall, Jillian A., Oliver B. Reid, and Lawrence W. Zettler.** Department of Biology, The Illinois College, Jacksonville, IL 62650 - A beneficial effect of low seed density on the development of *Encyclia tampensis* (Orchidaceae): First demonstration for an epiphytic orchid.
- 1:30 198. **Deraimo, David, Amy Britt, Jagan V. Valluri, and H. Wayne Elmore.** Dept. Biological Sciences, Marshall University, Huntington,

WV 25755 - Protein synthesis and stress ethylene production in sandalwood callus cultures exposed to heat shock.

- 1:45 199. **Al-Hamdani, Safaa H. and Nichols, P. Brent.** Jacksonville State University - Spectral Characteristics and leaf gas exchange of *Kalmia latifolia*.
- 2:00 200. **Connell, Shounda and Safaa al-Hamdani.** Department of Biology, Jacksonville State University, Jacksonville, AL 36265. Kudzu Response to Selected Concentrations of Sodium Chloride.
- 2:15 201. **Tolbert, Virginia, J. D. Joslin, B. R. Bock, F. C. Thornton, D. E. Pettry, W. Bandaranayake, S. Schoenholtz, A. Houston, D. Tyler, S. B. McLaughlin.** Oak Ridge National Laboratory, Oak Ridge, TN 37831 - TVA, Muscle Shoals, AL, MS State U, Stoneville, MS, Univ. TN/Ames Plantation, Grand Junction, TN - Belowground carbon sequestration associated with conversion of agricultural lands to bioenergy crop cultivation.

Evolution - Dogwood Room

Presiding: Dr. Kamal Mohammed - Sony St. University, New York.

- 2:30 202. **Lickey, Edgar B., Laura McGhee, and Karen W. Hughes.** Department of Botany, University of Tennessee, Knoxville, TN 37996 - Variability in the occurrence of a Group I intron in several species in the Auriscalpiaceae (Homobasidiomycetes).
- 2:45 203. **McElroy, Tom C. and Walter J. Diehl.** Mississippi State University - Genotypes of multiple allozyme loci interact with an experimental environment to affect survivorship in earthworms (*Eisenia andrei*).
- 3:00 **BREAK**

Mammal Biology - Dogwood Room

Presiding: Dr. David Webster - University of North Carolina - Wilmington

- 3:30 204. **White, Christine and Isaure de Buron.** Converse College, Spartanburg, SC 29302 - Histological alterations of equine placenta due to fescue toxicosis.

- 3:45 205. **Wilson, Barbara L. and William David Webster.** Dept. Biological Sciences, University of North Carolina at Wilmington, Wilmington, NC 28403-3297 - Microhabitat selection in the eastern woodrat, *Neotoma floridana* (Mammalia: Rodentia: Muridae), in the northeastern most part of its geographic distribution.
- 4:00 206. **Jeffries, Michael N., Timothy J. Gaudin, and William P. Stevens.** Dept. of Biological & Environmental Sciences, University of Tennessee at Chattanooga, Chattanooga, TN 37403 and Dept. of Biology, Georgetown College, Georgetown, KY 40324 - Biogeography of the short-tailed shrew (*Blarina brevicauda* and *B. carolinensis*) in the Tennessee River Valley and adjacent areas of the mid-south.
- 4:15 207. **Gaudin, Timothy J. and Jeremy L. Bramblett.** Dept. of Biological and Environmental Sciences, University of Tennessee at Chattanooga, Chattanooga, TN 37403 - Preliminary Report on Late Pleistocene Bats from Lookout Mountain, Tennessee.

Animal Ecology Hilton Hotel - Azalia Room - Session 2

Presiding: Dr. Susan Carstensen, Emory University

- 1:00 208. **Stewart, Kevin D. and Richard M. Duffield.** Dept. Biology, Howard University, Washington, DC 20059 - *Sialis vagans* (Ross)(Megaloptera: Sialidae) trapped by Mountain Laurel (*Kalmia latifolia* L.)(Ericaceae).
- 1:15 209. **Siegle, Tracey E. and Elaine S. Chapman.** Department of Biology, The Illinois College, Jacksonville, IL 62650 - A preliminary survey of tick populations in rural Pike Co., Illinois.
- 1:30 210. **Reeves, Will K.** Dept. of Entomology, Clemson University - Seasonality in southeastern cave invertebrates.
- 1:45 211. **Hamilton, Robert IV, Janet W. Reid, and Richard M. Duffield.** Dept. Biology, Howard University, Washington, DC 20059 and Dept. Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560 - Novel copepod abundant in leaves of *Sarracenia purpurea* L.

- 2:00 212. **Williams, Ray S.** Dept. Biology, Appalachian State University, Boone, NC 28608 - Responses of the gypsy moth to elevated CO₂ and temperature grown maple species.
- 2:15 213. **Luce, Austine A., Crowe, Mary.** Department of Biology, Coastal Carolina University, Conway, SC 29528 - Investigations into the behavior and ecology of juvenile ghost crabs, *Ocypode quadrata*.
- 3:00 214. **Haney, Dennis C. and Wade W. Worthen.** Department of Biology, Furman University, Greenville, SC 29613 - Temperature tolerance in three mycophagous *Drosophila* species: relationships with community structure.
- 3:00 **BREAK**

Cellular/Molecular Biology Hilton Hotel - Azalia Room

Presiding: Dr. Ken Shull, Appalachian State University

- 3:30 215. **Jin, Eun-Jung and Giselle Thibaudeau**, Mississippi State University - LICI-induced phosphoprotein involved in pigment development in the embryonic zebrafish (*Brachydanio rerio*).
- 3:45 216. **Van Valkenburg, Doug and Dwayne Wise.** Department of Biological Sciences, Mississippi State University, MS 39762 - Evidence for the alteration by B chromosomes of the metaphase checkpoint in meiotically dividing cells of a species of grasshopper.
- 4:00 217. **Kupfer, Holly and Dwayne Wise.** Mississippi State University - The sex chromosomes of flea beetles achieve proper orientation and segregation during meiosis without change in tension.
- 4:15 218. **Brunner, Jessica J., Richard N. Henson, and Mary U. Connell.** Appalachian State University - The reevaluation of *Diplocentrus* sp. using molecular techniques.
- 4:30 219. **Upchurch, Robert A., Kim Norris-Caneda, and Jessica Young.** Dept. Biology, Coastal Carolina University, Conway, SC 29528 - Using molecular sexing identification to aid raptor rehabilitation.

Cryptogamic Botany Convention Center - Room A

Presiding: Dr. Harold Marshall, Old Dominion University

- 8:00 220. **Marshall, Harold and Lubomira Burchardt.** Dept. of Biological Sciences, Old Dominion University, Norfolk, VA 23529 and Dept. of Hydrobiology, Adam Mickiewica University, Poznan, Poland - Phytoplankton dynamics within the tidal freshwater region of the James River, Virginia.
- 8:15 221. **Wolny, Jennifer, David Seborn, and Harold Marshall.** Dept. of Biological Sciences, Old Dominion University, Norfolk, VA 23529 - Results of a distribution survey for *Pfisteria piscicida* and similar dinoflagellates in Virginia estuaries.
- 8:30 222. **Kokolis, Michelle, David Seaborn, Jennifer Wolny, and Harold Marshall.** Dept. of Biological Sciences, Old Dominion University, Norfolk, VA 23529 - The composition and long term trends associated with phytoplankton assemblages in the lower Chesapeake Bay.
- 8:45 223. **Schnittler, Martin and Steven L. Stephenson.** Dept. Biology, Fairmont State College, Fairmont, WV 26554 - Myxomycete biodiversity in four different forest types in Costa Rica.
- 9:00 224. **Risk, Allen C.** Morehead State University - Kentucky's moss flora: additions and noteworthy collections.
- 9:15 225. **Romain, Reginald and L. Frederick.** Howard University, Washington, DC - *Chaetomium* sp. as a probable cause of a leaf spot of *Ficus lyrata*.
- 9:30 226. **Toure, Oumar, Raymond L. Petersen, and Pamela J. Edwards.** Dept. of Biology, Howard University, Washington, DC 20059 and USDA Forest Service, Northeastern Research Station, Parsons, WV 26287 - The apparent adaptation of the pigeon moss, *Polytrichum commune* Hedw. (Polytrichaceae) to soils affected by acid mine drainage.
- 9:45 227. **Risk, Allen C.** Morehead State University - Bryophytes of the Obed Wild and Scenic River, Tennessee.

10:00 **BREAK**

- 10:30 228. **Faust, Andrea and Raymond L. Petersen.** Dept. of Biology, Howard University, Washington, DC 20059 - Age estimates of colonies of the cinnamon fern, *Osmunda cinnamomea*.

Developmental Biology Convention Center - Room A

Presiding: Giselle Thibadeau, Mississippi State University

- 10:45 229. **Nurcahyani, Nuning and Giselle Thibadeau.** Mississippi State University. Spatial influences on neural crest-derived pigment cell differentiation and migratory activities.
- 11:00 230. **Rayburn, James R.** Dept. of Biology, Jacksonville State University, Jacksonville, AL - The Use of the Grass Shrimp *Palaemonetes pugio* Toxicity Assay for the Identification of possible population differences.
- 11:15 231. **Roberson, Carolyn, Eun-Jung Jin, and Giselle Thibadeau.** Mississippi State University - Analysis of melanophore differentiation in zebrafish under normal and treated conditions.

Aquatic/Wetlands Ecology Seminar Convention Center - Room B

Presiding: Dr. Barbara Rafaill - Georgetown College

- 8:00 232. **Campo, Frank M., Gary P. Shaffer, Mark W. Hester, and Daniel W. Llewellyn.** Dept. Biological Sciences, SLU 10736, Southeastern Louisiana University, Hammond, LA 70402 and LA Dept. Natural Resources, Coastal Restoration Division, 625 N. 4th St., P.O. Box 94396, Baton Rouge, LA 70804-9396 - *In Situ* hurricane simulations on two age classes of baldcypress (*Taxodium distichum* (L.) Richard) seedlings.
- 8:15 233. **Willis, Jonathan M. and Mark W. Hester.** Dept. of Biological Sciences, Southeastern Louisiana University, Hammond, LA 70402 - Effects of salinity, flooding depth, and soil organic content on *Panicum hemitomon* adventitious root production and biomass partitioning.

- 8:30 234. **Hester, Mark W. and Irving A. Mendelssohn.** Dept. of Biological Sciences, Southeastern Louisiana University, Hammond, LA 70402 and Wetland Biogeochemical Institute, Louisiana State University, Baton Rouge, LA 70803 - Long-term vegetative recovery from an oil spill in a Louisiana salt marsh: experimental manipulations of elevation and sediment.
- 8:45 235. **Shaffer, Gary P., Rachel A. Dowty, Mark W. Hester, Gary W. Childers, Michael C. Greene, and Frank M. Capo.** Southeastern Louisiana. Bioremediation of small-scale oil spills in fresh marsh habitats: a mesocosm approach.
- 9:00 236. **Fortino, Kenneth and Robert P. Creed, Jr.** Department of Biology, Appalachian State University, Boone, NC - Biotic influences on the distribution and abundance of stream-dwelling crayfish in the New River.
- 9:15 237. **Brown, Bryan L., William E. Dobson, and Robert P. Creed,** Dept. of Biology, Appalachian State University, Boone, NC 28608 - Distribution, abundance, and symbiotic interactions of an aquatic symbiotic worm on two sympatric species of host crayfish.
- 9:30 238. **Beard, Charles E. and Peter H. Adler.** Clemson University. Trichomycete fungi: the unexplored frontier.
- 9:45 239. **Hochman, E. Rachel,** Department of Biology, University of North Carolina at Chapel Hill, NC 27599-3280 - Impacts of altered river hydrology on regeneration and growth of floodplain trees on the lower Roanoke River, North Carolina: a template for conservation of Southeastern bottomland forests.
- 10:00 **BREAK**

Plant Systematics Convention Center Room C

Presiding: Patricia Cox, University of Tennessee

- 8:00 240. **Smith, Gerald L., C. Craig Moretz, and Fred T. Yeats.** High Point University and North Carolina Wild Flower Preservation Society - Spider-lilies of the Atlantic Coastal Plain.

- 8:15 241. **Floyd, Jennifer W.** Dept. of Botany, North Carolina State University - Phylogenetic analysis of *Gaylussacia* (Ericaceae) using ITS.
- 8:30 242. **Smith, Gerald L. and Nancy C. Coile.** High Point University and Division of Plant Industry - Florida Department of Agriculture & Consumer Services - Distinctions between *Hymenocallis choctawensis* and *Hymenocallis lirusme*.
- 8:45 243. **Rebecca R. Bray.** Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529-0266 - Colonial quillwort--A new species of *Isoetes* from York County, Virginia.
- 9:00 244. **Musselman, Lytton John and W. Carl Taylor.** Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529-0266 and Department of Botany, Milwaukee Public Museum, 800 West Wells Street, Milwaukee, WI 53233-1478 - A new diploid *Isoetes* from freshwater tidal rivers of Virginia.
- 9:15 245. **Pittman, Albert B. and Ann Darr.** South Carolina Heritage Trust Program - A new species of Aster (Compositae) from the sandhills of South Carolina.
- 9:30 246. **Perry, James D.** University of North Carolina at Asheville, NC 28804 -Morphology of *Sabatia* pollen and seed with scanning electron microscopy.
- 9:45 247. **Davenport, L.J.** Department of Biology, Samford University, Birmingham, AL 35229 - The Cahaba lily: Endangered species or cultural icon?
- 10:00 **BREAK**
- 10:30 248. **Kartesz, John T. and Robert B. Cox.** Biota of North America Program, CB #3280 Coker Hall, UNC-Chapel Hill, NC 27599 - A Visual Polyclave Computer Key for the North American Flora.
- 10:45 249. **Rundell, Hannelore and Michael Woods.** Department of Biological Sciences, Troy State University - The vascular flora of Ech Lake, Dale County, Alabama.
- 11:00 250. **Marcum, Paul B. and Dan K. Evans.** Herbarium, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755-Origin of the

sterile hybrid *Crex x deamii* F.J. Herman (Cyperaceae) using Macro and Micro Morphological Characters.

- 11:15 251. **Hunter, Gregory A.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - Herbal medicine of Bill Wyckle, a Southern Appalachian herbalist.
- 11:30 252. **Evans, Dan K.** Dept. Biological Sciences, Marshall University, Huntington, WV 25755 and Catholic University, Quito, Ecuador. Medicinal plants of the indigenous Shuar and Achuar people in Southeastern Ecuador.

Animal Physiology Convention Center Room C

Presiding: Dr. Kamal Mohamid, Sony St. University, New York

- 4:15 253. **Hogan, G. Richard.** Department of Biology, Austin Peay State University, Clarksville, TN 37044 - Inhibition of selenomethionine - induced leukopenia in mice by testosterone.
- 4:30 254. **Peterson, Jay A. and Jay A. Yoder.** Department of Biology, The Illinois College, Jacksonville, IL 62650 - Investigation on large dermal gland secretions in the lone star tick, *Amblyomma americanum*, as a means to conserve water.
- 4:45 255. **Crouch, Kelly C., Benjamin W. Stevens and Jay A. Yoder.** Department of Biology, The Illinois College, Jacksonville, IL 62650 - Long distance attraction to a mammalian-derived skin secretion (squalene) by the lone star tick, *Amblyomma americanum*.
- 5:00 256. **Blank, Sarah M., Jeff D. Weaver, and John J.** Just. University of Kentucky - Partial characterization of hatching enzymes from three different Osteichthyes species.
- 5:15 257. **Hooker, J. Benjamin and M. J. Sedivec.** Appalachian State University. Effects of 1,1,3-tricyano-2-amino-1-propene (Triap) on functional recovery from a crushed sciatic nerve in rats.

Plant Ecology - Session 2 Convention Center Room D

Presiding: Dr. Donald Windler, Towson State University

- 8:00 258. **Zettler, Lawrence W., Jennifer A. Sunley, and Tonya Wilson Delaney.** Department of Biology, The Illinois College, Jacksonville, IL 62650 - Symbiotic micropropagation of the yellow fringeless-orchid, *Platanthera integra*, from the Green Swamp, North Carolina.
- 8:15 259. **Stucky, Jon M. and Donna S. Wright.** North Carolina State University - *Solidago verna*, a disturbance-adapted, endangered plant species of the Carolinas.
- 8:30 260. **Sobieraj, James H., II and Howard S. Neufeld.** Department of Biology, Appalachian State University, Boone, NC 28608 - Hydraulic architecture of *Galax urceolata*, an evergreen, understory herb of the southern Appalachians.
- 8:45 261. **Ulrey, Christopher J. and Thomas R. Wentworth.** Dept. Botany, North Carolina State University, Raleigh, NC 27695-7612 - Evaluation of ordination procedures using field and simulated data: analysis of the Thompson River data.
- 9:00 262. **Hudson, Jarvis E.** Fayetteville State University - Twenty-three years of change in an oak-dominated forest.
- 9:15 263. **Ulrey, Christopher J., Thomas R. Wentworth, and Peter R. Minchin.** Dept. Botany, North Carolina State University, Raleigh, NC 27695-7612 and Dept. Biological Sciences, Louisiana State University, Baton Rouge, LA 70803 - A comparison of Detrended Correspondence Analysis and Non-metric MultiDimensional Scaling using vegetation data from the Southern Appalachians.
- 9:30 264. **Wally, Alaa L.** Ecology Curriculum, University of North Carolina, Chapel Hill, NC 27599-Effects of canopy on viability in a population of the federally endangered pitcher plant *Sarracenia jonesii*.
- 9:45 265. **White, Rickie D.** University of North Carolina at Chapel Hill - The impact of Hurricane Fran on the vegetation of a North Carolina Piedmont woodland.

10:00 **BREAK**

Presiding: Dr. Thomas Wentworth, NC State University

- 10:30 266. **Collins, Beverly and Loretta Battaglia.** Savannah River Ecology Lab and Louisiana State University - Microenvironmental heterogeneity and *Quercus michauxii* seedling growth in experimental canopy gaps.
- 10:45 267. **Brown, Rebecca L.** Ecology Curriculum, University of North Carolina, Chapel Hill, NC 27599-3275 - Species richness of native and exotic plants in southern Appalachian riparian zones.
- 11:00 268. **Dilustro, John J. and Frank P. Day.** Old Dominion University, Norfolk, VA 23529 - Fine root growth and demographic responses to elevated carbon dioxide in an oak-palmetto scrub ecosystem.
- 11:15 269. **Asomani, Kwame and Richard M. Duffield.** Dept. Biology, Howard University, Washington, DC 20059 - Macroinvertebrate populations of treeholes in Fort Foote Park, Prince George's County, Maryland.
- 1:00 270. **Taylor, David D. and Deborah L. White.** USDA Forest Service, Winchester, KY 40391 and Kentucky State Nature Preserves Commission, Frankfort, KY 40601 - Status of the threatened plant, *Solidago albopilosa*: population trends, threats and opportunities.
- 1:15 271. **Spence, Crystall and Scott B. Franklin.** Department of Biology, University of Memphis - Classification and ordination of forest stands in Natchez Trace State Forest, TN.
- 1:30 272. **Geissinger, Karen E., Howard S. Neufeld and Robert Sutter.** Department of Biology, Appalachian State University, Boone, NC, The Nature Conservancy, Chapel Hill, NC - Grazing influences on plants in a southern Appalachian mountain bog.
- 1:45 273. **Semler, Brooke A. and A. Joseph Pollard.** Department of Biology, Furman University, Greenville, SC 29613 - Colonization of a man-made pond by bunched arrowhead, *Sagittaria fasciculata*, with observations on possible dispersal by muskrats.

- 2:00 274. **Augenfeld, Kimberly and Scott B. Franklin.** University of Memphis, Memphis, TN 38152 - Over a decade of change in a natural shortleaf pine community at Land Between the Lakes.
- 2:15 275. **McLeod, Kenneth W.** Savannah River Ecology Laboratory, University of Georgia, Aiken SC 29802 - Reforestation of severely disturbed bottomland forest sites.
- 2:30 276. **Claridge, Kevin and Scott B. Franklin.** University of Memphis, Memphis, TN 38152 - Potential Effects of an Exotic Invasive Plant on Erosion, Soil Nutrients, and Aquatic Primary Production.
- 2:45 277. **Knebell, Larissa, Aaron Cooper and J. Dan Pittillo.** Western Carolina University - Changes in old growth hemlock (*Tsuga canadensis*) forests in the Cataloochee watershed of the Great Smoky Mountains National Park.
- 3:00 **BREAK**

Presiding: Dr. Joseph Winstead, Morehead State University, KY

- 3:30 278. **Estep, Bret and L. S. Barden.** Biology Department, University of North Carolina at Charlotte, Charlotte, NC 28223 - Ecotypic variation in Schweinitz's sunflower *Helianthus schweinitzii*: Implications for endangered species management.
- 3:45 279. **Mettler, Paige A., Marian Smith and Kelly Victory.** Dept. Plant Biology, Southern Illinois University, Carbondale, IL 62901 and Southern Illinois University, Edwardsville, IL 62026 - Alternative disturbance regimes for the threatened floodplain species, *Boltonia decurrens*.
- 4:00 280. **Allen, Bruce P., Eric F. Pauley and Rebecca R. Sharitz.** Savannah River Ecology Laboratory and Coastal Carolina University - Vegetation dynamics and response to disturbance in a southeastern floodplain forest.
- 4:15 281. **Savidge, Timothy W. and Dale W. Suiter.** Planning and Environmental Branch, North Carolina Department of Transportation, Raleigh, NC 27611 - The North Carolina Department of Transportation's methods to offset impacts to the federally Threatened *Hexastylis naniflora*.

- 4:30 282. **Suiter, Dale W. and Timothy W. Savidge.** Planning and Environmental Branch, North Carolina Department of Transportation, Raleigh, NC 27611 - The North Carolina Department of Transportation's management of roadside populations of rare plant species.
- 4:45 283. **Baucom, Regina, James Estill and Mitch Cruzan.** University of Tennessee, Knoxville - The effect of corporate logging on genetic diversity of *Acer saccharum*.
- 5:00 284. **Tyndall, R. Wayne.** Maryland Department of Natural Resources, P. O. Box 68, Wye Mills, MD 21679 - Vegetation change in a Carolina Bay in Maryland over an 11-year period.
- 5:15 285. **Pollard, A. Joseph, C. Brannon Andersen, and Sandra K. Wheeler.** Departments of Biology, Earth and Environmental Science, Chemistry, Furman University, Greenville SC 29613 - Biogeochemistry of trace metals at the Chunky Gabbroic/ultramafic site, North Carolina.

BETA BETA BETA BIOLOGICAL SOCIETY

The following papers are not listed in the order in which they will be presented. The schedule for these presentations will appear in the Beta Beta Beta program available at the meeting. Additional titles may have been submitted to the final program.

Southeastern Region District I

Albert, Marianne. Molecular Cloning of Gene Sequences to Optimize In-Situ Hybridization. Sigma Gamma, Erskine College.

Cappiello, Alexandra. The Effect of Hsp 70 on the Injury Response of the Squid Giant Axon. Beta Rho, Wake Forest University.

Crisp, Jeremy. Synergistic Effects of Rifabutin and Amphotericin B against *Aspergillus in vitro*. Sigma Gamma, Erskine College.

Fumi, Erica and Tim Lightfoot. Strain Screening for Inherited Oxygen Consumption Capability. Tau Lambda, University of North Carolina at Charlotte.

Hand, Valerie. The Role of Interleukin-10 in Immunity to Larval Cestodes. Beta Rho, Wake Forest University.

Hartwell, Hadley J. Comparisons of the Hindlimb Extensor Muscle, *Semimembranosus*, in the Leopard Frog, *Rana pipiens*, and the Marine Toad, *Bufo marinus*. Tau Lambda, University of North Carolina at Charlotte.

Hjelmeland, Mark. The Fractal Geometry of Dimorphism in *Canada albicans*. Tau Eta, Catawba College.

Koblansky, Alicia and T. Steck. Resistance of Viable but Nonculturable Bacteria to Antibiotics. Tau Lambda, University of North Carolina at Charlotte.

Madden, Jessica. The Effects of Antibacterial Handsoap on Skin Bacteria. Tau Eta, Catawba College.

Morgan, Liane R. Induction of the Viable for Nonculturable Condition in *Escherichia coli*. Tau Lambda, University of North Carolina at Charlotte.

Morgan, Scott and Penny Duerksen-Hughes. Detection of Genotoxicity of Environmental Chemicals by p53 ELISA. Eta Psi, Georgia State University.

Ossowski, Kathryn. The Effect of Larval Cestode Products on Host Fibroblasts. Beta Rho, Wake Forest University.

Pham, Dat and T. Steck. Viable-but-nonculturable (VBNC) State in *Rhizobium leguminosarum*. Tau Lambda, University of North Carolina at Charlotte.

Ryan, Valerie. *In vitro* Formation of the Nucleoprotein Complex that Triggers Initiation of DNA Replication in *E. coli*. Sigma Psi, Florida Institute of Technology.

Scheidt, William. Population Demographics of Giraffe, *Giraffa camelopardalis*, in Arusha National Park and Mt. Meru Forest Preserve, Tanzania. Beta Rho, Wake Forest University.

Sexton, Jennifer. Autism Associated with Partial Trisomy in Chromosome 2p. Sigma Gamma, Erskine College.

Velleff, Jason. Effects of Dihydrofolate Reductase Inhibitors, Singly and in Combination of *Klebsiella pneumoniae*. Sigma Psi, Florida Institute of Technology.

Wanat, Karoline. Cell Cycle Expression of Proteins Regulating Initiation of DNA Replication in *E. coli*. Sigma Psi, Florida Institute of Technology.
District I, Poster Titles:

Dunlap, Amanda L. Determining Differences in Feeding Behavior Between Two South Carolina Crop Pests, *Nezara viridula* and *Leptoglossus phyllopus*. Psi, Winthrop University.

Gancarz, Brandi. Characterization of Microbes Associated with Marine Invertebrates. Sigma Psi, Florida Institute of Technology.

Gibson, Diedrea. Effect of the Estrous Cycle on Renin mRNA Expression. Tau Upsilon, Belmont Abbey College.

Johnson, Brian. The Characterization of Nuclear Receptors in *Dugesia dorotcephala* and Their Role in Regeneration. Psi, Winthrop University

Legrand, Karine. Effect of Various Dihydrofolate Reductase Inhibitors, Used Singly and in Combination, on *in vitro* Growth of *E. Coli*. Sigma Psi, Florida Institute of Technology.

Park, Margaret. KH Domains: A Type of RNA-Binding Domain, and Two KH Domain-Containing Proteins: Vertebrate Vigilin and Its Yeast Homologue SCP160p. Sigma Gamma, Erskine College.

Sexton, Jennifer. Characterization of Cytokine and mRNA Levels During the Induction Phase of Autoimmune Orchitis in BALB/cByJ and BALB/cJ Mice. Sigma Gamma, Erskine College.

Ward, James T. The Possible Anti-Microbial Activity and Histochemistry of the Mucoid Cells in the Planarian *Dugesia dorotocephala*. Psi, Winthrop University.
District II Paper Titles:

Dosset, Lesly. Effects of Cell Culture and Cryopreservation on the Expression of Na⁺, K⁺-ATPase in Bovine Corneal Endothelial Cells. Mu Gamma, Western Kentucky University.

Franklin, Victoria. Environmental Influence on Crayfish Carapace Color. Pi Delta, East Tennessee State University.

Hornbuckle, Lauri. PCR Analysis of the Archaeal *Sulfolobus acidocaldarius* for the Fibrillarin-Encoding Gene. Beta Upsilon, Georgetown College.

Marshall, John. The Effects of a Solid Waste Landfill on the Distribution and Diversity of the Small Mammalian Fauna. Mu Gamma, Western Kentucky University.

Millro, Candace. Population Genetics of a Chagas Disease Vector in Guatemala. Eta Lambda, Loyola University.

Owens, Daniel. Development of an Assay for Flavanone-3-Hydroxylase Activity employing Capillary Electrophoresis. Pi Delta, East Tennessee State University.

Roy, Karla. Testing for Geographic Heterogeneity in Genotype Frequencies when Sample Sizes are Small and Diversity is High. Mu Gamma, Western Kentucky University.

Timmerman, Anne M. Virulence Factors in *Enterococcus faecalis*. Mu Upsilon, University of Tennessee, Martin
District II Poster Titles:

Burkpile, Deron E., Matthew T. Moore, and Marjorie M. Holland. Susceptibility of Five Non-Target Freshwater Species to the Organophosphate Insecticide Dioxin. Beta Kappa, University of Mississippi.

Cline, Amy. Encystment and Transformation of the Freshwater Mussel, *Utterbackia imbecillis*, on Bluegill, *Lepomis macrochirus*, in Stream Water Versus Control Water. Eta Pi, Austin Peay State University.

France, Amy. Matrix-Assisted Laser Desorption/ionization Time-of-Flight Mass Spectrophotometry of Hydrophobic Peptides. Mu Gamma, Western Kentucky University.

Slaughter, Jennifer N. Synthesis of Cannafimmetric Indoles. Mu Upsilon, University of Tennessee, Martin.

Author Index for Papers and Posters with Abstract Numbers

A		
Adams, J.	106	
Al-Dujaili, J.S.	87	
Al-Hamdani, S.H.	199	
Albert, M.	BBB	
Aderman, J.	184	
Allen, B.P.	227,280	
Allison, J.R.	77	
Anders, C.M.	70	
Asomani, K.	269	
Augenfeld, K.	274	
B		
Bagga, D.K.	156	
Barmore, J.G.	129	
Barnett, K.G.	180	
Barreras, B.E.	99	
Barthet, M.	20	
Barry, R.E.	149	
Baskauf, C.J.	78	
Basinger, M.A. ..	162,166	
Baucom, R.	283	
Beard, C.E.	238	
Beck, M.	115	
Belcher, R.T.	9	
Bernstein, M.	40	
Berry, M.L.	62	
Bickford, N.	94	
Blair, B.G.	92	
Blank, S.M.	256	
Bockoven, B.	147	
Boetsch, J.R.	160	
Bone, S.	190	
Bonner, L.A.	28	
Boyce, K.A.	152	
Bradbury, A.	93	
Bray, R.D.	243	
Brown, B.L.	237	
Brown, C.M.	170	
Brown, R.L.	267	
Brubaker, D.A.	164	
Brunner, J.J.	218	
Brzostowski, L.	32	
Burse, J.R.	140	
Burdette, J.D.	86	
Burkpile, D.E.	BBB	
C		
Campo, F.M.	232	
Camper, J.D.	113	
Cappriello, A.	BBB	
Carter, E.B.	80	
Carter, J.	116	
Claridge, K.	276	
Cline, A.	BBB	
Collins, B.	266	
Connell, S.	200	
Conner, J.L.	22	
Conner, W.H.	13	
Cooper, A.	53	
Corn, E.	10	
Cornwell, K.	38	
Couch, J.	41, 107	
Coxe, R.	248	
Crisp, J.	BBB	
Crouch, K.C.	255	
Cruzan, M.	68	
D		
Davenport, L.J.	247	
Davis, C.	24	
Deraimo, D.	198	
Desroches, D.J.	194	
Diehl, D.	25	
Dilustro, J.J.	52, 268	
Dohogne, M.	124	
Dolin, R.E.	29	
Dosset, L.	BBB	
Dunlap, A.	BBB	
Durako, M.	173	
Durrant, G.	120	
E		
Ebony, B.	88	
Edwards, M.L.	5	
Eskew, K.R.	96	
Estep, B.	278	

Estill, J. 65
 Evans, D.K. 252

F

Faulkner, S. 15
 Faulkner, S.P. 14
 Faust, A. 228
 Floyd, J.W. 241
 Fortino, K. 236
 Foster, S. 26
 Foster, T. 37
 France, A. BBB
 Franklin, V. BBB
 Frederick, L. 90,91
 Friece, M.P. 60
 Fumi, E. BBB
 Funderburke, L. 18

G

Gamble, R. 131
 Gancarz, B. BBB
 Gaudin, T. J. 207
 Gaugler, M.S. 100
 Geissinger, K.E. 272
 George, R.Y. 176
 Gibson, D. BBB
 Ginger, J.V. 188
 Gladden, J. 141
 Goodin, J.T. 137
 Gray, M. 127
 Greene, J.L. 103
 Gregory, J. 11
 Guill, J.M. 136

H

Haldeman, J.H. 48
 Hamilton, H. 19
 Hamilton, R. 211
 Hancock, T. 154
 Hand, V. BBB
 Haney, D. C. 214
 Hanlon, S. 125
 Hartwell, H.J. BBB
 Harvey, M.C. 35
 Heins, D.C. 134
 Helms, B.S. 192

Herbst, E.C. 139
 Hester, M.W. 234
 Hjelmeland, M. BBB
 Hochman, E.R. 239
 Hodson, R. 179
 Hogan, G.R. 253
 Holt, T. 64
 Hood, C.S. 135
 Hooker, J.B. 257
 Hooker, V.E. 122
 Hornbuckle, L. BBB
 Howard, G.C. 143
 Howerton, K.B. 85
 Hudson, J.E. 262
 Hughes, M. 144
 Humphries, W.J. 110
 Hunter, G.A. 251
 Hupp, C. 155

J

Jackson, N.C. 138
 Jagan, V.V. 66
 James, M.M. 51
 Jeffries, M.N. 206
 Jin, E.-J. 215
 Johnson, B. BBB
 Johnson, J.M. 142
 Johnson, J.W. 102
 Jolls, Claudia 277-A
 Jones, T. 153
 Joplin, K.H. 7
 Justice, G. 123

K

Karriker, L. 101
 Kartesz, J. T. 163
 Knebel, L. 277
 Koblansky, A. BBB
 Kokolis, M. 222
 Kruczynski, B. 172
 Kupfer, H. 217

L

Lacey, E.L. 76
 Langley, S.K. 61
 LeBlond, R. 74

Legrand, K. BBB
 Leiden, Y.A. 148
 Levy, F. 79
 Lickey, E.B. 202
 Lindley, B. 108
 Livingston, M.R. 89
 Lowman, B.M. 186
 Luce, A. 213

M

Madden, J. BBB
 Madsen, D.L. 58
 Marcum, P.B. 250
 Marshall, H. 220
 Marshall, J. BBB
 Marshall, J.A. 197
 Martin, S.B. 193
 Marvin, G.A. 6
 Mathis, M.J. 67
 McCartney, E.A. 71
 McCartney, G.A. 104
 McElroy, T.C. 203
 McGuire, R.F. 121
 McKenna, M. 59
 McKerrow, A.J. 171
 McLeod, K.W. 275
 McMullen, C.K. 168
 McVaugh, R. ... Sympos.
 Mecham, J.A. 43
 Mellinger, C. 81
 Menges, E.S. 75
 Menhinick, E.F. 33,34,36
 Metter, P.A. 279
 Miller, H.A. 63
 Millro, C. BBB
 Mohr, J.R. 105
 Morgan, J.A. 185
 Morgan, L.R. BBB
 Morgan, S. BBB
 Morris, A.B. 49
 Murdy, W.H. 80
 Musselman, L.J. 244
 Muth, C.C. 160

N

Nelson, D. 130

Neufeld, H.S.	165
Newman, M.C.	128
Nichols, P.B.	97
Nurcahyani, N.	229

O

O'Connell, A.M.	31
O'Connell, M.	44
Ogden, J.	175
Ossowski, K.	BBB
Owens, D.	BBB

P

Park, M.	BBB
Patti, H.D.	12
Pauley, B.A.	111
Pauley, E.F.	46
Pauley, T.K.	30,46, 111, 114
Peet, R.K.	159
Perry, J.D.	246
Peterson, J.A.	254
Pham, D.	BBB
Phillips, G.	2
Pittillo, J.D.	169
Pittman, A.B.	245
Pollard, A.J.	285
Poppy, S.M.	145
Poss, S.	177

R

Rabon, O.R.	39
Raimondo, S.	112
Rayburn, J.R.	230
Reeves, W.K.	210
Rentch, J.	167
Ressler, D.A.	84
Risk, A.C.	224
Ritchie, J.C.	15
Ritland, D.B.	4
Robeson, M.	21
Roberson, C.	231
Rogers, H.L.	55
Rogers, S.O.	95
Romano, F.A.	98

Romain, R.	225
Rose, T.L.	183
Roy, K.	BBB
Rundell, H.	249
Ryan, T.J.	146
Ryan, V.	BBB

S

Saffore, L.Y.,	42
Sandhu, R.	196
Sauterer, R.A.	119
Savidge, T.W.	281
Scheidt, W.	BBB
Schening, M.,R.	57
Schnittler, M.	223
Schwartz, F.J.	151
Semler, B. A.	273
Sexton, J.	BBB
Shacochis, K.	8
Shaffer, C.P.	235
Sharma, G.K.	159
Shening, M.	57
Sheridan, P.	45
Shull, J.,K.,Jr.	117
Siegle, T.E.	209
Slaughter, J.N.	BBB
Smith, G.L.	240,242
Sobieraj J.	260
Sorrie, B.A.	73
Souther, R.F.	195
Spanovich, S.	109
Spence, C.	271
Spicer, J.S.	126
Spratt, H.G., Jr.	83
Stalter, R.	158
Stapleton, A.E.	23
Stephenson, S.L. .	17,47
Stewart, K. D.	208
Stucky, J.M.	259
Suchecky, P.F.	50
Sucke, A.C.	150
Suiter, D.W.	282

T

Taylor, D.D.	270
Thompson, A.	189
Thompson, R.L.	56
Timmerman, A.M. .	BBB
Tolbert, V.	201
Tomasek, T.	187
Toure, D.	226
Tuberville, T.D.	1
Tyndell, W.R.	284
Tzeng, M.W.	132
Ulrey, C.J.	261,263
Upchurch, R.A.	219

V

Van Valkenburg, D.	216
Vargo, G.	174
Veleff, J.	BBB
Vibmenay, A.	16
Vogel, V.	82
Vu, N.T.	27

W

Wally, A.L.	264
Wanat, K.	BBB
Ward, J.T.	BBB
Webberking, A.L.	54
Webster, D.	178
Weigant, P.L.	118
Welch, N.T.	72
Werth, C.R.	69
White, C.	204
White, R.D.	265
Whitekiller, R.R.	3
Williams, R.S.	212
Willis, J.M.	233
Wilson, B.L.	205
Winstead, J.E.	191
Wolny, J.	221
Woodson, H.W.	132
Wooten, M.S.	182
Wykle, J.	181

Z

Zettler, L.W.	258
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REVIEWS

Dr. Frank Schwartz, Review Editor
Institute of Marine Science, 3431 Arendell St.
University of North Carolina, Morehead City, NC 28557

Goldstein,, R. J. 1997. *Marine Reef Aquarium Handbook*. Barron's Educational Ser., Hauppauge, NY. \$9.95. 198 p.

Are you frustrated, are our fish dying, and is your marine reef tank a disaster? Relax, your concerns are now a thing of the past. You too can have a vibrant living coral reef aquarium that may even win at an aquarium show if you follow suggestions found in Goldstein's 6 1/2x 7 7/8" (16.5 x 20 cm) *Marine Reef Aquarium Handbook*. Not only are you introduced to how to set up your reef aquarium; he leads you by the hand in what to do, what is best to buy, where to buy it, and a lot of other information. You learn what is the good, the bad, and the ugly to use in terms of equipment, operation, habitability, and even invertebrates and fishes. Twenty-three fact-filled chapters comprise the volume, of which Chapter 13 on corals is the largest. Chapters treat: mature reefs, basic equipment; water quality, rock, gravel and sand; nitrogen and carbon cycles; power heads and water pumps; filters; protein skimmers; UV sterilizers and ozonizers; temperature control; light and lighting; algae and plants; corals; diseases of corals; sponges, molluscs; crustaceans; echinoderms; annelids; urochordata; fishes - foods and feeding; fishes - care and breeding; and diseases of fishes. This volume is enhanced (even the covers) by 170 photographs (161 in color) of equipment and organisms, a list of measurements (when mixing up solutions), an up-to-date list of references (p. 184-191), glossary (p. 192-194), and an index (p. 195-198). The volume seems waterproof.

I find little to quibble about other than some measurement units are not metric. Why, with the two column format, weren't more species depicted instead of just mentioning species differences in the text? Recent researchers have shown that nematocysts are triggered following a chemical reaction between victim and nematocyst instead of just being shot out (p. 77). The plural of aquarium is aquaria (p. 164 and 175). The term fishes should refer to more than one species instead of just one species (p. 165). Spelling of Etawetok should be Enewtak, (p. 2). Several color photos are too dark to be useful on pages 91, 96, 136, 177, and the red Lima shrimp is not distinguishable on p. 137.

I really can only rave about this volume, and feel everyone — aquarist, layperson, and scientist — should consult or have a copy, of this handbook on their shelves. No longer will I have to reply to a neophyte or senior aquarist why or what went wrong with their marine reef aquarium, for now all I have to do is reach for Goldstein's *Marine Reef Aquarium Handbook*. It has all the answers, and the price is right.

FRANK J. SCHWARTZ. *Institute of Marine Sciences, University of North Carolina, Morehead City, NC 28557-3209.*

Sherman, P.W. and J. Alcock (eds). 1998. *Exploring Animal Behavior* Sinauer Press Sunderland, MA \$18.95 paper. 300 p

This softback book is a second edition of articles relating to animal behavior, reprinted almost entirely from articles first appearing in the *American Scientist*. A quick perusal of the articles and their illustrations will probably make one think that these have been seen before; certainly, some have been in *American Scientist*, but many are referred to in Alcock's popular and well-written textbook, *Animal Behavior*. This is not coincidental. These articles were chosen to supplement *Animal Behavior* and to that end, they could be valuable for a student of animal behavior. The 30 articles making up the book, having appeared before, stand on their own and need only be judged on the basis of whether they are appropriate for their intended audience: undergraduate students in an introductory animal behavior course. I will first briefly review the articles and then consider whether they seem appropriate for a typical student of animal behavior.

The 300 page book is divided into five parts each containing from five to eight articles. The first part "Doing Science" seems to be an odd assortment of papers, only two of which relate to animal behavior (*Infanticide as a Primate Reproductive Strategy* by S. B. Hrdy and *Primate Social Behavior in a Changing World* by R. Curtin and P. Dolhinow). Even these do not address the often unique methods of animal behavior such as constructing an ethogram or the more common techniques of defining, observing, recording and analyzing behavior. Alcock effectively uses Hrdy's research in his textbook to illustrate hypotheses generation from the obvious problem of why a male langur would kill the infants in a troop of which he had just taken control. The behavior certainly seems maladaptive, since the survival of the troop would depend on surviving young, until one considers that those infants that are killed do not have genes in common with the new male leader.

The other three articles in this first part--*Integrity in Science* by Lewis Branscomb, *Conduct, Misconduct and the Structure of Science* by James Woodward and David Goldstein and *The Science of Scientific Writing* by George Gopen and Judith Swan--even though interesting and informative to individuals already knowledgeable of how science is done--do not start from where the introductory student must start and that is defining and observing behavior and writing a clear, logical report.

The second part, "Mechanisms of Behavior", has a number of interesting articles. In terms of methods it is hard to beat Holekamp and Sherman's article *Why do male ground squirrels disperse?* The reader is led through the different possible explanations that could explain dispersal and is given data supporting and not supporting each hypothesis. The conclusion that some combination of physiological, developmental, fitness and evolutionary reasons are needed to explain male ground squirrel's dispersal very effectively illustrates the complexity of seemingly simple behavior. The idea that a given behavior can have multiple causes and multiple explanations is well illustrated.

What does alcoholism, smoking, hyperactivity, pathological gambling and antisocial behavior have in common? Other than the fact that they are considered "inappropriate"

by our society, they may share a common genetic cause. This is an inherited lack of the normal number of dopamine receptors resulting in a person who has to seek extra sensation or pleasure. The article, *Reward Deficiency Syndrome* by Blum, Cull, Braverman and Comings, makes a compelling case that an inherited low number of dopamine receptors in the limbic system (the pleasure center of the brain) results in "sensation seeking" behavior to compensate. This reward deficiency syndrome can result in a multitude of impulsive, compulsive and addictive behaviors.

The next few articles seem to portray the diversity of behaviors and associated mechanisms, ranging from mimicry in starlings (*Mozart's Starling* by M.J. West and A.P. King) to the adaptive responses of flying insects to bats, especially moths, and the various counter-responses of different kinds of bats (*Moth Hearing and the Feeding Strategies of Bats* by M.B. Fenton and J.H. Fullard; *Aerial defense Tactics of Flying Insects* by M. May).

Completing the mechanism section are two articles relating to hormones and behavior of the sexes. The first, *Testosterone and Aggression in Birds* by J.C. Wingfield, G. F. Ball, A.M. Dufty, Jr., R. E. Hegner and M. Ramenofsky, focuses on the role of testosterone in male bird aggressiveness and how this works. Since the relation between aggression and testosterone in male birds is not perfect, environmental variables may be a mediator. Many variables were suggested, and generally eliminated, leaving the variable of the presence of another male as the one most directly related to elevated testosterone levels in the blood. The next article, *Shaping Brain Sexuality* by A.H. Bass, considers the mechanisms causing two kinds of males in the midshipman fishes. The Type I male fish is larger, establishes a territory and has a large vocal apparatus to call females. The Type II male is a "sneaker" who, resembling a female (small, with no territory and makes no call), sneaks into the den of the Type I male to fertilize eggs left by a female. During development the Type I male has a type of testosterone (11-ketotestosterone) which apparently causes the enlarged size and vocal apparatus. It may be that ecological, behavioral and genetic factors all contribute in part to the prevalence of this type testosterone in some males.

The third section has articles relating to the evolutionary history of behavior starting with S. J. Gould's article, *Evolution and the Triumph of Homology, or Why History Matters*. Gould traces the usefulness of the historical method used effectively by Darwin to answer questions that can't be answered by the standard method of controlled investigations. The comparative method is basically historical and its usefulness is nicely demonstrated in the articles in this section. Hölldobler and Wilson use the comparative method in looking for the origin of nest-weaving in ants (*The Evolution of Communal Nest-weaving in ants*). Web-spinning ants were divided into three grades of corporation that seem to parallel the evolutionary history of the ants. In the most advanced grade, the larvae provide the silk and they are used by the workers like a shuttle for weaving the nest. In other grades the larvae move the silk and the workers simply held the larvae.

It is not often that one sees a web constructed by a web-spinning ants but spider webs are encountered frequently. William Shear used the comparative method to trace the evolution of the spider's web in the article, *Untangling the Evolution of the Web*. Even

though the pattern of webs might seem to provide a good account of spider evolution they give much less information than that gleaned from anatomy, ecology and behavior of spiders.

One of the more interesting courtship behaviors is that of the bowerbird who builds elaborate bowers to attract females. How did this behavior evolve and what advantages must it confer to both male and female for it to have evolved? These questions are asked and answered by Gerald Borgia in the article *Why do Bowerbirds Build Bowlers?*

The final article of this section (*Hunter-Gatherers of the New World* by Kim Hill and Magdalena Hurtado) analyzes present tribes of human hunter-gathers to see if their behavioral patterns fit our assumptions of the conditions under which humans evolved. An analysis of the Ache of Paraguay and published accounts of the !Kung of Africa, among others, suggest that there are only a few common patterns of behavior. Environmental constraints may be a more important variable in behavioral patterns of societies than we may have thought.

Part four, "The Adaptive Value of Reproductive Behavior", contains six interesting articles. The first two focus on the evolutionary origins of behavioral and morphological differences between the sexes. Randy Thornhill and Darryl Gwynne focus on *The Evolution of Sexual Differences in Insects* by considering the Williams and Trivers hypothesis that the sex who contributes most to the offspring will be the one who makes the choice of mates. We often associate the role of mate choice with the female but this article reviews role reversals in which the male chooses the female. Male Mormon crickets provide a nutritious spermatophore which the female eats while the male mates with her. Since the male provides essential nutrition when the supply of food is low, he chooses the female (choosing large, healthy females). By contrast, when the food supply is plentiful, the females will choose the male from their song. Katyids, scorpionflies and butterflies show similar patterns of behavior and add support to the hypothesis.

Mate choice by females may involve more than protection or food resources. William Eberhard in the article *Animal Genitalia and Female Choice* makes the case that female mate choice has been the major reason for the wide variety of male genitalia.

In the article *Prairie Vole Partnerships* Lowell Getz and Sue Carter show how the low quantity of food for voles in the tallgrass prairies probably led to the evolution of their community structure.

We tend to think that the sex of an animal is fixed, and in most species it is, but Robert Warner's article entitled *Mating Behavior and Hermaphroditism in Coral Reef Fishes* illustrates the widespread prevalence of hermaphroditism in these fishes. He poses the question of the adaptive significance of hermaphrodites and compares the mating systems of coral reef fishes, some hermaphrodites and others not. Size of the male seems to be a major variable. If, for example, one dominant male has a harem of a number of smaller females, it would be an advantage for one of the larger females to change sexes and take over the harem if the male dies. Yet it would be no advantage for a female to change to a male if her change would not put her (him) in a dominant position and as a subordinate male would wind up being a parent to less offspring than by staying a female.

Using basic principles from evolutionary biology, David Buss attempts to outline the strategies humans may be using in mate selection. The article *The Strategies of Human Mating* summarizes survey data from over 10,000 men and women in 37 countries in order to test nine specific hypotheses generated from evolutionary theory. A few of the hypotheses are: "Men seeking a short-term mate will solve the problem of identifying fertile women; Men seeking a long-term mate will solve the problem of paternity confidence; Women seeking a long-term mate will prefer men who can provide resources for their offspring." All the hypotheses were supported by the data suggesting that we are still using evolutionary strategies in our behavior.

The final article in this part, *Avian Siblicide* by Douglas Mock, Hugh Drummond and Christopher Stinson, asks why it could be adaptive for parents to let one sibling kill another. If there is not enough food for two, one will kill the other rather than both be weakened and possibly die. If there will almost never be enough resources for two, one will always kill the other (obligate siblicide), the second offspring being insurance against the first not surviving.

Section five is "The Adaptive Value of Social Behavior," with six articles on social behavior, including some intriguing animals such as the naked mole-rats and bee-eaters.

The first article of the section, *Why Ravens Share* by Bernd Heinrich and John Marzluff ask how the altruistic act of sharing food by ravens could have evolved. Wandering ravens need only follow a group of ravens in the morning to find a source of food. Ravens will even display by soaring to communicate a change in roosting site nearer to a new source of food. Why should the ravens be so cooperative? Heinrich and Marzluff conclude by noting that "ravens share because their system serves the common good by harnessing self-interest, not suppressing it." (p.250)

The article by Rodney Honeycutt, *Naked Mole Rats* focuses on why this small 20 to 30 gram animal living in extensive runways below ground in the hard soil of Kenya is eusocial with one reproductive queen and many "workers". Even though they don't have haplodiploidy sex determination as the honeybees do, they are highly inbred with offspring possibly being more related to each other than to their parents. Environmental factors such as limited food and presence of predators makes living in large groups (70 -80 individuals) an advantage which may have predisposed them to eusociality.

The bee-eaters of Kenya, described in the article, *Making Decisions in the Family: an Evolutionary Perspective* by Stephen Emlen, Peter Wrege and Natalie Demong, focus on the decisions a bird must make (e.g., stay with the family or start a new family) to increase his/her inclusive fitness. Since helpers at the nest are needed, making sure that one's kin survive is increasing indirect fitness. A female helper can become a "parasite" by laying her own egg in the nest of relatives she is helping. The set of decision rules a male and female may take concerning family behavior are nicely illustrated in the article and provide insight into the basis of seemingly complex decision making.

Two articles dealing with honeybees (*The Honey Bee Colony as a Superorganism* by Thomas Seeley and *The Essence of Royalty: Honey Bee Queen Pheromone* by Mark Winston and Keith Slessor) approach this social system from a perspective of

information flow in the colony. Seeley makes a strong case for considering a bee colony as a superorganism, with individual bees comparable to cells in a multicellular organism. He traces the information flow in a colony and notes that information involves cues rather than signals. Since a complex, central information processor such as the brain is not needed with cues (e.g., if workers have to wait to unload nectar, they will slow down their rate of foraging), the superorganism can evolve.

Winston and Slessor trace the discovery of the mandibular pheromone in the honeybee queen and how it functions to cause the workers not to raise other queens, not to swarm, suppress worker reproduction and cause workers to form a circle around the queen (retinue response).

In summary, this is a book loaded with interesting, well written articles that would be an excellent supplement to an animal behavior class. The only exception to this generalization is the editors' choice of articles in the first part dealing with "Doing Science".

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Wise, Kenneth and Ron Petersen, 1998. **A Natural History, of Mount Le Conte**, The University of Tennessee Press, Knoxville, xxv + 137 pages. ISBN 1-57233-010-4 \$15.95

The Great Smoky Mountains National Park is one of the, most heavily visited places in America. This is due in part to the numerous vehicles that simply drive through the Park on US 441. There are, however, many wonderful areas to be seen on foot along the various trails. Whether you spend minutes, hours, or days viewing the Park on foot, you may encounter an amazing collection of sights ranging from the minute structure of a moss leaf to the grandiose panorama of a mountain range. The trees and wildflowers are the first objects that come into view, with diversity not easily matched elsewhere. Various animals may be seen, if the visitor is knowledgeable about their habits and has the patience to seek them out. But the visions that make the Smokies most famous are of the mountains themselves. The rugged peaks, some looming over 5,000 feet high, are well known, as are, the parallel ridges of mountains arranged so as to give seemingly endless vistas. When a visitor first encounters the, Smokies, it is all he can do to absorb a bit of the endless array of information, There is so much variety there, that one can become lost exploring in one little corner of the....,but wait, there is help!

People want to know about the plants, animals, rock formations and mountains that they see here, especially the more striking ones. To make sense out of the Park in a short period of time, you need help from experienced persons, The authors are well versed in the details of the trails and plants of the Park. According to their guide, "Mount Le Conte is the crown jewel of the Great Smoky Mountains," and "harbors the greatest concentration of notable geologic features in all of the Smokies," These rock formations are ancient, among the oldest on the continent. The plant associations and habitat types are also relatively, old, due partly to the fact that the effects of climatic change having

been felt less here than in most other areas of North America for many millions of years. Mt. Le Conte harbors a tremendous collection of natural specialties characteristic of the Smokies.

This slim handbook is described as "not intended as a hiking guide but rather an introductory history of Mount LeConte," Nevertheless, there is some attempt to furnish a description of the mile-by-mile terrain as one hikes along the various trails leading up the mountain. One can hike up and spend the night in a lodge near the top, or simply hike a while and then turn back. There are six main trails seeking the summit from non-overlapping sections of the slopes. Each trail, and the summit, has a chapter devoted to it in the book. An introductory chapter tells about the history of exploration of the mountain. Mount. LeConte was named after John LeConte, a professor of Physics at South Carolina College who helped Samuel Buckley measure the height of Clingmans Dome in 1858. Mount LeConte had earlier been determined to be 6,612 feet above sea level (by Buckley, Clingman and Guyot).

I found the text to be entertaining and well written. Anecdotes about history, people, manmade structures and natural features make up the bulk of the text. Prominent plants (and animals) are mentioned on occasion, but there is no effort to provide complete coverage of the vegetation or forest formations along the trails. There is a listing of common and scientific names of plants in the back. The novice will not find much use for this book in plant identification. There are no drawings or helpful descriptions of plants, just mention of them as if you know them already from other places and wish to know their significance in the situation at hand.

The book is illustrated with numerous black and white photos throughout the text, mostly of geologic formations, waterfalls, and dwellings. The image quality ranges from good to fair. I think some may have been made from color photos, and some from very old photos, hence some visual details have been lost. There is also a useful bibliography for further readings, and an index,

The items most strikingly missing from the book are maps. There is one woefully, small map of Mount Le Conte and its trails that is the frontispiece. This lack of detailed maps is frustrating as each chapter gives a good description of the trail and mileage to various checkpoints.

Curiously, there is a list of maps in the front with the *indication* that the maps themselves are to be found inside a back cover pocket, but I did not have such a pocket in my copy, nor did I see any indication of once having been affixed and removed. Fortunately, other maps are available for hikers, but it diminishes the value, of the book not to have them available as indicated.

Overall this handy volume would add significantly to one's enjoyment of hiking on Mt. Le Conte by providing historical background and general description of sights and natural phenomena along the trails. It would not provide any real help to the novice with the identification of plants, animals, or specific geology; it did not claim to be such a guide anyway. For lovers of the Great Smoky Mountain National Park, this book provides something of a history, both natural and human.

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NEWS OF BIOLOGY IN THE SOUTHEAST

Jon R. Fortman-News Editor
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ABOUT PEOPLE AND PLACES

GEORGIA

Savannah River Ecology Laboratory. Dr. Whit Gibbons, has received a Choice Outstanding Academic Book Award. *Ecoviews: Snakes, Snails and Environmental Tales*, is a compilation of articles written by Gibbons and his coauthor and sister, Ann Gibbons. The book is published by the University of Alabama Press. To be nominated for the Choice Award, a book must have been reviewed by Choice in the previous 12 months. Of those, just ten percent are named to the Outstanding Academic Books list.

MISSISSIPPI

University of Mississippi, Department of Biology. Dr. Steve Threlkeld has been named Managing Editor of *Estuaries*. Dr. Richard Buchholz (Ph.D. University of Florida) has joined the faculty as Assistant Professor of Biology. Dr. Stephen Secor (Ph.D., UCLA) joined the faculty in January 1999 also as an Assistant Professor of Biology.

Mississippi University for Women, Division of Science and Math. Dr. Jimena Aracena has joined the faculty after completing her Ph.D. at the University of Kansas. She is a native of Oruro, Bolivia, and is fluent in five languages. She will be teaching Animal Physiology as well as other biology courses.

NORTH CAROLINA

Appalachian State University, Biology Department. The state legislature of North Carolina has appropriated six million dollars for an addition to Rankin Science Building. The Biology Department will expand into this addition, and will more than double its floor space. Construction is to begin within the year.

TENNESSEE

University of Tennessee, Knoxville. Dr. Massimo Pigliucci has been elected Secretary of the Ecological Section of the Botanical Society of America for 1999-2001. He is also organizing a symposium on the evolution and molecular biology of phenotypic plasticity for the upcoming International Botanical Congress in St. Louis, MO., August, 1999.

MUSEUMS, HERBARIA AND BOTANICAL GARDENS

ALABAMA

Anniston Museum of Natural History, Anniston. The Museum presented the annual Garden & Home Lecture Series in February, 1999. *Ellen Riley*, assistant garden editor with Southern Living magazine was the speaker. Other lectures were given in March and April by *Daniel Whitsett* and *Marcia Weber*.

Troy State University, Department of Biological Sciences. The Troy State University Herbarium currently houses more than 2,500 specimens. The holdings include vascular plants, bryophytes, and lichens all primarily from southeast Alabama. Also represented are vascular plants from the Jackson Purchase Area of Kentucky (Calloway and Hickman Counties). Unmounted plant specimens from various southern Alabama localities and the Jackson Purchase Area of Kentucky are available on an exchange basis. Contact Michael Woods or Alvin Diamond for further information.

GEORGIA

Michael C. Carlos Museum, Emory University. The Museum presented "Beads, Body, and Soul" Feb. 6 through April 11, 1999. Yoruba-speaking peoples are among the most numerous in Africa, with an estimated population of more than 25 million. Their arts and religion have also flourished in the Diaspora and are at the heart of African-American traditions in Cuba, Brazil, and the United States. Much of their fabric of life is revealed through its beaded arts. The exhibition is the first to focus on a wide range of beaded traditions in West Africa and the Americas, both past and present.

ABSTRACTS

- 1 TUBERVILLE, TRACEY D.¹, J. RUSSELL BODIE², JOHN B. JENSEN³, LINDA LACLAIRE⁴, J. WHITFIELD GIBBONS¹. ¹University of Georgia's Savannah River Ecology Laboratory, ²University of Missouri-Columbia, ³Georgia Department of Natural Resources, and ⁴U. S. Fish and Wildlife Service - Ecology and perceived decline of the southern hognose snake, *Heterodon simus*.

The southern hognose snake, *Heterodon simus*, is a fossorial snake whose range is restricted to the Coastal Plain of the southeastern United States. This secretive species is infrequently encountered, was probably historically uncommon, and is believed by many herpetologists to be declining. We reviewed and summarized all of the available literature relating to this species, contacted herpetologists in each state within its known range, obtained Element Occurrence Records from the Natural Heritage Programs of each state, and acquired information from various museum collections. Though well-documented trend information is lacking, the southern hognose snake may be extirpated from Mississippi and Alabama. However, in other portions of its range, some southern hognose populations appear to be stable at this time. Habitat destruction and degradation, road mortality, and the introduction and spread of red imported fire ants are possible factors leading to the species' perceived decline in much of its range, although inconsistencies in survey effort and the southern hognose snake's secretive nature may contribute to an underestimation of their population size and vigor. Research on the basic ecology of this species is needed. Efforts to survey historical localities and monitor known populations are encouraged

- 2 PHILLIPS, GARY AND SAMRAH A. RAOUF. Department of. Biology, Coastal Carolina University, Conway, SC 29528. Avifauna survey of an Atlantic Coast Barrier Island.

We censused the avifauna found on the salt-water marsh and along the shore-line of an undeveloped Atlantic barrier island known as Waites Island, SC. We initiated the census in September 1998 and it will continue through the breeding season of 1999. Between September and November of 1998 we have recorded 95 species that use this location. Four of these species, the piping plover (*Charadrius melodus*), the wood stork (*Mycteria americana*), the peregrine falcon (*Falco peregrinus*) and the bald eagle (*Haliaeetus leucocephalus*) are threatened or endangered species. Piping plovers appear to use the areas as stop-over sites during migration as well as an over-wintering site. The young wood storks appear to disperse into the marsh areas after fledging since the largest numbers were observed in September, although a few individuals were observed in early November. The peregrine falcons appear to use the area during migration and the bald eagles appear to be residents. Of the remaining 91 species, 20 appear to be winter residents on Waites Island and the remainder appear to be migrants utilizing the area as a stopover site. Our data thus far suggest that Waites Island is a very important natural area for both migrant and resident birds, some of which are federally endangered or threatened species.

- 3 WHITEKILLER, ROBIN R.¹, DAVID F. WESTNEAT², PATRICIA L. SCHWAGMEYER¹ AND DOUG W. MOCK¹. ¹Dept. Zoology, University of Oklahoma, Norman, OK 73019 and ²Dept. Biological Sciences, University of Kentucky, Lexington, KY 40506 - Badge size and extra-pair fertilizations in the house sparrow, *Passer domesticus*.

Although house sparrows are considered mainly monogamous, females solicit extra-pair copulations (EPCs) and are targets for forced EPCs. Moller (1990) has suggested that large-badged males perform more EPCs than small-badged males, while also copulating more often with their own mates. In this study we determined whether large-badged males (1) have fewer extra-pair offspring in their nests than small-badged males, (2) have greater reproductive success than small-badged males, and (3) guard their mates more intensely than small-badged males. Of 41 broods and attending adults, 16% of the nestlings were unrelated to the attendant males. Thirty-five percent of the males were cuckolded; however, we found no relationship between badge size and percent of extra-pair young in the nest. We also found no relationship between badge size and reproductive success. There was also no significant relationship between badge size and amount of time males spent guarding their mates; however, we did find a positive significant relationship between percent extra-pair young in the nest and amount of time a male spent guarding his female. Males may adjust mate guarding intensity to their perceived risk of paternity loss.

- 4 RITLAND, DAVID B. Erskine College, Due West, SC 29639 — Mayhem in the Monarch's Court: Viceroy (*Limenitis archippus*) Mimicry Revisited.

In its most familiar manifestation, defensive mimicry involves an otherwise defenseless prey species (the mimic) that gains protection from predators through its resemblance to a protected prey species (the model). The Viceroy butterfly (*Limenitis archippus*) is well known as a striking and purportedly defenseless mimic of two chemically defended and aposematic models, the Monarch (*Danaus plexippus*) and the Queen (*Danaus gilippus*). However, a decade's worth of laboratory and field studies have revealed unanticipated dimensions of complexity in the viceroy's mimicry relationships. Here, I assess spatiotemporal variation in the relationship among viceroys, monarchs, and queens. Seasonal and geographical patterns of relative abundance and palatability are quantified, and those data are used to calculate an aversive conditioning index for each species in several southeastern U.S. locales. Results reveal that viceroys, queens, and to a lesser extent monarchs all switch between being "models" (strong aversive conditioners) and "mimics" (weak aversive conditioners), depending upon ecological context. Consequently, viceroy-queen and viceroy-monarch relationships in different areas comprise a spatial mosaic of local model-mimic relationships differing in character and symmetry. This has important implications for understanding the dynamic selective forces involved in this and other predator-prey relationships.

- 5 EDWARDS, MARY LANG AND DAVID RITLAND. Erskine College, Due West, SC 29639 — Home Range of an Eastern Box Turtle, *Terrapene c. carolina*, on a residential island habitat.

The long-lived Eastern box turtle (*Terrapene c. carolina*) is an important member of the Piedmont oak-hickory-pine forest community, and is an increasingly threatened barometer of ecosystem health. Increasing urbanization and habitat fragmentation in much of the box turtle's range have unfortunately created an opportunity to study how turtle populations fare on shrinking habitat islands, and how human encroachment affects the metapopulational dynamics of this and other woodland species. This poster addresses the home range dynamics of a single box turtle of a deme of >90 individuals inhabiting an 8-ha "island woodland" within a residential neighborhood located in the piedmont of South Carolina. This turtle, one of 10 being monitored via radiotelemetry, exhibits striking seasonal variation in home range size and microhabitat preference, yet remarkable year-to-year fidelity in choice of foraging range and hibernation site. Identifying the environmental variables and navigational cues that drive these behavioral patterns is the first step in deciphering critical habitat features that must be preserved in order to maintain viable populations of this and other eastern forest denizens.

- 6 MARVIN, GLENN A^{1,2}. ¹Dept. Zoology, University of Oklahoma, Norman, OK 73019 and ²current address Dept. Biology, University of Montevallo, Montevallo, AL 35115 — Territorial behavior of the salamander *Plethodon kentucki*: influence of habitat structure and population density.

To investigate territorial behavior of the salamander *Plethodon kentucki*, I conducted a 3-year mark-recapture study and determined home-range characteristics and spatial relationships of individuals at two field sites that differed in predominant cover type and population density. I tested the hypothesis that this species is territorial and that larger adults occupy higher quality territories. I examined whether home ranges were fixed and mostly exclusive, and conducted removal studies to test for defense of home areas. Home ranges of adults were fixed and the home ranges of same-sex adult neighbors were mostly exclusive. The spatial arrangement of home ranges was usually random for juveniles, and significantly regular within aggregations of adults. Analyses of nearest-neighbor sex indicated a positive intersexual association of adult home ranges. Removal studies provided evidence for defense of adult home ranges only at the high-density site. The location of gravid-female home ranges had a strong influence on the distribution of male home ranges. At the high-density site, larger males may have had greater reproductive success than smaller males because they were more dominant and their home ranges overlapped a greater number of gravid-female home ranges. My results indicate that *P. kentucki* can be territorial. Additionally, variation in habitat structure and population density may influence the spatial organization and mating system of this species.

- ⁷ JOPLIN, KARL H. AND DARRELL MOORE Dept. Biological Sciences - 70703, East Tennessee State University, Johnson City, TN 37614 - Behavioral chaos within groups of nonsocial flies?

The locomotor activity patterns of the nonsocial flesh fly, *Sarcophaga crassipalpis*, were analyzed with respect to density. Groups of 1, 4 and 8 male flies were maintained in identical 25cm rectangular plexiglas chambers with a water source on one end and a sugar supply on the other. Activity was measured at 4 equally spaced motion detectors under 12 h light:12 h dark (LD 12:12) cycle, constant dark (DD) and reentrainment to LD 12:12. Our results demonstrate a statistically significant differential spatial distribution along the length of the chamber for groups of 4 and 8 flies during the light phase, but a random distribution for single flies. All groups show a random distribution during the dark phase of the LD cycle. Preliminary time series analyses suggest that a non-random, phase space attractor appears in the temporal activity of these flies at any given motion detector.

- 8 SHACOCHIS, KRISTEN, JEFFREY DEBERRY, DARREN LOOMIS, ROBERT BELCHER AND ROBERT ATKINSON. Dept. Biology, Chemistry and Environmental Science, Christopher Newport University - Plant composition within a chronosequence of Atlantic White Cedar, *Chamaecyparis thyoides*, wetlands in Virginia and North Carolina.

Chamaecyparis thyoides (L.) B.S.P. historically occurred in isolated, even aged stands as far north as Maine, south to Florida and west to Mississippi along the Gulf coast states. Extensive logging, fire suppression and improper management of Atlantic white cedar stands have led to a decline in habitat. Eight sites representative of juvenile (< 10yrs.), intermediate (10 – 30yrs.), and mature (> 30yrs.) age classes were selected for study in northeastern North Carolina and southeastern Virginia. Vegetative analysis of tree (>2.5cm dbh), shrub (<2.5cm dbh) and herb (< 30cm tall) strata was performed in plots located on permanent transects in each site. Dominant tree species were found to be *C. thyoides* > *Acer rubrum* > *Nyssa sylvatica* in mature stands, *C. thyoides* > *A. rubrum* > *Gordonia lasianthus* in intermediate age stands and herbs including *Eupatorium capillifolium* > *Pteridium aquilinum* > *Andropogon virginicus* in juvenile stands. The presence of *A. rubrum* in Atlantic White Cedar stands may present a threat to restoration and management of this ecosystem.

- 9 BELCHER, ROBERT T., TRAVIS R. COMER AND ROBERT B. ATKINSON. Dept. Biology, Chemistry, and Environmental Science, Christopher Newport University - Morphometric and physiological responses to shading in Atlantic white cedar, *Chamaecyparis thyoides* (L.) B.S.P. cuttings.

Light intensity has been recognized as an important factor in the growth, survival, and competitive success in restoration projects involving *Chamaecyparis thyoides* (L.) B.S.P. However, there is no consensus regarding light requirements of the species. In this study, sixty, two year old bare root *C. thyoides* cuttings were planted in peat mesocosms in March, 1998 and grown under six different shade treatments. Individual tree height and basal diameter were recorded monthly April through November and photosynthetic response curves were used to evaluate light compensation and saturation points. *Chamaecyparis thyoides* survivorship exceeded 98%. One way analysis of variance and Student-Newman-Keuls method of pairwise multiple comparison revealed significant growth rate differences ($p < 0.05$) between (1) the control and 73, 85, and 95 percent shading and (2) the 55 percent shade treatment and 85 and 95 percent shading. These results suggest that two year old *C. thyoides* can survive up to 95% shade, but low growth rates reduce chances for competitive success.

- 10 CORN, ELIZABETH, ROBERT ANGUS, AND KEN MARION. University of Alabama at Birmingham - Benthic macroinvertebrate community indices in tributaries of the Cahaba River in Alabama: effects of urbanization.

Urban growth around Birmingham is rapidly enveloping the watershed of the upper Cahaba River. During 1998, we investigated the status of benthic macroinvertebrate communities in seven tributaries of the upper Cahaba. Of these, one was relatively undisturbed; three were primarily impacted by sediment from recent construction activities; three were located in areas which had been urbanized for 15-20 years (reduced sedimentation, but a variety of non-point effects). Samples were collected in riffle areas with a kick net during summer and fall and preserved in EtOH. One hundred specimens were randomly selected

for each site per season and identified to genus level. Benthic community indices were calculated for each tributary. Most indices indicated that tributaries classified as primarily sediment impacted scored higher than streams classified as general urban. Both groups scored lower than the control tributary or the extreme upper Cahaba. Preliminary results suggest that streams which continue to be impacted by a range of detrimental environmental factors over time, as in urban situations, will show little if any recovery from the initial impacts of sedimentation.

- 11 GREGORY, JARRETT A., BRAD P. SCHLOMER, KARL H. JOPLIN. Dept. Biological Sciences - 70703, East Tennessee State University, Johnson City, TN 37614-Stress effects of environmental contaminants in freshwater organisms.

Freshwater organisms are exposed to an increasing amount of environmental contaminants. Although it is relatively easy to measure the amount of these contaminants in water samples, the question remains; At what levels of these pollutants does the organism perceive to be stress? We have examined this in both vertebrate and invertebrate systems as well as the question of whether these organisms respond to different stresses by a similar mechanism by looking at the involvement of the heat shock response to heavy metal and organic compounds. Lethal heat shock treatments were determined for the fat head minnow, *Pimephales promelas* and the midge, *Chironomid tetans*. A one hour exposure at 36°C and 35°C, respectively was lethal, while a prior heat treatment of 31°C protects against the lethal effects. Lethal concentrations of cadmium, copper, benzene and ethylene glycol were determined and the protective effect of the thermoprotective treatment was measured.

- 12 PATTI, HEATHER D. Department of Botany, North Carolina State University. Effects of an altered hydrological regime on species composition and tree productivity in a bottomland hardwood forest, Sampson County, North Carolina.

There is an increasing need to examine how human activities affect wetlands having high water quality functions like bottomland hardwood forests. Although work has been done on the effects of long term inundation on these forests, little effort has been exerted on the effects of soil saturation. The purpose of the current study is to determine how long term hydrological change affects plant species composition and tree productivity in a bottomland hardwood forest community in Sampson county, North Carolina. An experimental and reference area were delimited, and base line water table and redox potential (Eh) data were recorded for 4 months. Current water table data are being used to better define the experimental area. Baseline vegetation data were also recorded (September, 1997). On March 3, 1998, a flashboard riser was installed in a second order stream to raise the water table bank full in the experimental area. Water table and redox potential measurements continued, and vegetation was re-sampled in September of 1998. Normalization of the water table height data to date depicted a 1.9" overall increase in the water table of the experimental area due to the riser installation. Soil redox potential values from two depths decreased by 123.3 mV at the 25 cm depth and 89.4 mV at the 10 cm depth in the experimental area. Vegetation cover data will be analyzed this winter, and tree productivity will be measured next year.

- 13 CONNER, WILLIAM H., L. WAYNE INABINETTE, AND CARRIE CUTHBERTSON. Baruch Forest Science Institute, Box 596, Georgetown, SC 29442 - Invasion of South Carolina wetland forests by an unwanted exotic - Chinese tallow.

Chinese tallow tree (*Sapium sebiferum* Roxb.), a naturalized exotic from eastern Asia, forms very dense monotypic stands and has become a serious competitor to native species in stream swamps along the coast from southern Texas to North Carolina. In this experiment we examined the competitive relationships among seedlings of baldcypress (*Taxodium distichum* (L.) Rich.), water tupelo (*Nyssa aquatica* L.), and Chinese tallow in full sun environments under flooded and drained conditions over a two-year period. In the drained treatment, leaf biomass of Chinese tallow was 2-4 times greater in year 1 and 11-27 times greater in year 2 than water tupelo and baldcypress, respectively. Stem biomass was 1.5-10 times greater in year 1 and 8-62 times greater in year 2 than water tupelo and baldcypress, respectively. Growth of Chinese tallow under flooded conditions was significantly reduced such that leaf and stem biomass values for Chinese tallow were

99.5% smaller than those in drained conditions. Baldcypress and water tupelo both grew better under flooded conditions, with water tupelo out-performing baldcypress. Indications are that Chinese tallow grows faster than native wetland species under moist well-drained conditions, but flooding is an effective means of controlling the species.

- 14 FAULKNER, SAMUEL P. AND ROBERT A. STEWART. Dept. Biological Sciences, Delta State University, Cleveland, MS 38733 - Relationship of soil physicochemical composition to growth of black needlerush (*Juncus roemerianus* Scheele) in northern Gulf of Mexico wetlands.

Soil and vegetation were collected from 32 monospecific stands of *Juncus roemerianus* from irregularly flooded tidal wetlands in Mississippi and Alabama. Soils were analyzed for physicochemical parameters including pH, exchangeable cations, total and sulfide S, total and hydrolyzable N, extractable P, total salts, organic C, and DTPA-extractable Fe and Mn. *Juncus* stands were measured for dry weight above- and belowground biomass, shoot and leaf density, and leaf height and basal diameter. Data were analyzed using stepwise multiple linear regression. Exchangeable K and Ca and surface salinity accounted for over 40% of aboveground biomass variability where all factors were considered. Using only stress factors, exchangeable Na and surface salinity predicted about 30% of aboveground biomass variability. Where all factors were used, organic C, total N, phosphate, and bulk density accounted for 65% and 56% respectively for shoot and leaf density. About 51% of height variability was accounted for by surface salinity, bulk density, and total sulfide in a stress factor model. No models met the $\alpha = 0.05$ criterion for prediction of belowground biomass.

- 15 RITCHIE, JERRY C. USDA ARS Hydrology Laboratory, Beltsville, MD 20705 - Grass hedges for erosion control.

Soil erosion is a major concern on the landscape around the world. Narrow, stiff grass hedges have been used to slow runoff and reduce soil loss caused by concentrated flow erosion; however, few quantitative data are available on their effectiveness. This study was designed to measure the effectiveness of narrow, stiff grass hedges as a conservation practice for reducing soil loss from fields. Eastern gamagrass [*Tripsacum dactyloides* L.] and *Miscanthus* [*Miscanthus sinensis* Andress] were used to establish grass hedges on a contour, across concentrated flow erosion areas. Eastern gamagrass and *Miscanthus* grew rapidly and, within two years, formed dense hedges that slowed runoff and reduced soil loss from the field. Topographic surveys made in 1991, 1995, and 1998 measured 4 to 12 cm of sediment deposited above the hedges. Estimates of erosion/deposition using the ^{137}Cs methodology ranged from -25 (erosion) to +30 (deposition) $\text{t ha}^{-1} \text{yr}^{-1}$. Erosion/deposition patterns were related to the original topography with low areas having the greatest deposition. Narrow, stiff grass hedges can be an alternative conservation tool for reducing soil loss and dispersing runoff from areas of concentrated flow channels in fields. Grass hedges while shown to be successful in this study should not be seen as a panacea but as another tool to control soil loss and runoff from agricultural fields. Continued efforts to control soil loss at the point of detachment are critical. Proper management of grass hedges is required. Grass hedges are an alternative vegetative conservation practice for reducing soil loss and dispersing runoff from areas of concentrated flow erosion on the landscape.

- 16 VILMENAY, ANNICK, ADERONKE AJALA, RAYMOND L. PETERSEN AND RICHARD M. DUFFIELD. Dept. of Biology, Howard University, Washington, DC 20059 - Foreign mosquito survivorship in the purple pitcher plant, *Sarracenia purpurea* L. (Sarraceniaceae).

Fifteen populations of *Sarracenia purpurea* L. along the east coast of the United States were surveyed for Diptera larvae. Larvae of the chironomid genus *Metriocnemus* were present in all 15 populations, while *Wyeomyia smithii*, the species-specific mosquito associate of *S. purpurea*, was present in 11 populations. No other species of mosquito larvae were detected. Based on these findings, it was hypothesized that other species of mosquito larvae cannot tolerate the environment of the *S. purpurea* leaves, a seemingly suitable habitat for a variety of mosquito species. The ability of *W. smithii* and *Aedes aegypti* larvae to survive and emerge as adults in pitcher plant water under controlled laboratory conditions was investigated. Both mosquito species had a high survivorship when raised in 12-well tissue-culture plates containing pitcher plant water. However, survivorship of *A. aegypti* larvae was 0% when larvae were raised in leaves of *S. purpurea* plants maintained in growth chambers under controlled conditions, while most *W. smithii* larvae

emerged as adults. The reason for this response is not known, possibly some *in situ* chemical and/or biotic factors present in the intact habitat of the pitcher-plant leaves play a role. These findings suggest that this phytotelomic ecosystem may have evolved to block the intrusion by foreign mosquitoes. Acknowledgments: Research supported by NSF-RIMI, the USDA Forest Service (Eastern Region), and Howard University.

- 17 STEPHENSON, STEVEN L.¹, YURI K. NOVOZHILOV², AND ADAM W. ROLLINS¹. Dept. Biology, Fairmont State College, Fairmont, WV 26554 and V. L. Komarov Botanical Institute, 197376 St. Petersburg, Russia - Occurrence and distribution of myxomycetes in tropical forests of Puerto Rico.

Most of what is known about the assemblages of myxomycetes (plasmodial slime molds) associated with particular types of terrestrial ecosystems has been derived from studies carried out in temperate regions of the world. The species associated with tropical forest ecosystems have received very little study. The objective of the present study is to obtain data on the occurrence and distribution of myxomycetes in tropical forest ecosystems of the Luquillo Experimental Forest in northeastern Puerto Rico. Primary emphasis is being directed towards five different forest types (tabonuco forest, secondary tabonuco forest, palo colorado forest, palm forest, and elfin forest) that are stratified roughly by elevation. Preliminary analysis of the data represented by more than 1,000 field and moist chamber collections of myxomycetes indicate that levels of species richness and abundance tend to be highest in tabonuco forest and secondary tabonuco forest, both of which are located at the low end of the elevation gradient. By contrast, species richness and abundance tend to be lowest in elfin forest, located at the high end of the elevation gradient. As such, the general pattern observed is that of decreasing diversity with increasing elevation.

- 13 FUNDERBURKE, LISA, RAYMOND L. PETERSEN, AND LAFAYETTE FREDERICK. Dept. of Biology, Howard University, Washington, DC 20059 - Preliminary investigation of probable mycorrhizal associations in the roots of the cinnamon fern *Osmunda cinnamomea* L.

Golden velvet easily detached mantles were observed on the lateral surfaces and root tips of *Osmunda cinnamomea* and suggested a possible ectomycorrhizal association. Subsequent microscopic examination revealed the presence of intercellular hyphal strands in the cortical tissue of the *Osmunda* roots, suggesting an endomycorrhizal association. Several fungal isolates were obtained from *Osmunda* roots by placing surface-sterilized sections on rose bengal agar, then by subculturing the fungi that grew on potato dextrose agar. Isolates included as yet unidentified members of the Zygomycetes, and anamorph stages of probable Ascomycetes. This is the first report of such probable mycorrhizal associations in the fern genus *Osmunda*. Further isolations and experimentation are being conducted. Acknowledgments: Research supported by the USDA Forest Service (Eastern Region) and Howard University.

- 19 HAMILTON, HEATHER C. AND JAMES R. GAREY. Department of Biology, University of South Florida, Tampa, FL 33620 - Applying molecular techniques to environmental studies of meiobenthic fauna.

The purpose of this study is to develop sequence tags for a set of marine meiobenthic fauna (meiofauna). These sequence tags, called molecular beacons, will be used to identify specific species of meiofauna that are indicative of pollution without having to sort them out and identify them by hand. The DNA of the meiofauna will be extracted directly from sediment samples and the 18S rRNA gene will be PCR amplified. The molecular beacons will then be used to identify meiofauna sequences of interest. Preliminary data to date consists of nuclear 18S rRNA sequences and mitochondrial 16S rRNA sequences of meiofauna from sediment samples taken from East Beach at Fort DeSoto Park. The cloned genes were sequenced using an automated sequencer, and the sequences were assembled using computer software. The species to which these genes belong were identified using BLAST searches. These experiments verify that meiofauna can be identified from DNA extracted directly from sediment. The next step will be to identify species of harpacticoid copepods and nematodes from a hand-sorted sediment sample and construct a molecular beacon from a 25-50 base pair fragment of the 18S rRNA sequence of these organisms.

- 20 Barthet, Michelle and Mary U. Connell Dept. of Biology, Appalachian State University, Boone, N.C. 28607 Isolation and initial analysis of the chloroplast DNA from *Scytosiphon lomentaria*.

Chloroplast DNA (cpDNA) was isolated from the marine brown algal *Scytosiphon lomentaria* collected at Chinuteague Inlet, Chinuteague, Va.. Individual thalli were rinsed twice in sterile seawater, frozen in liquid nitrogen, transported to the lab, and stored at -80° C. A protocol modified from Fain et. al. (1988) was used to collect chloroplasts by differential centrifugation. Isolated chloroplasts were lysed, and cpDNA purified on a CsCl density gradient (1.699 g ml⁻¹). DNA bands were visualized using Hoechst dye (H33258) and cpDNA bands identified by comparison to both an *E.coli* density standard and total DNA from *Scytosiphon*. The cpDNA was concentrated following CsCl and Hoechst dye removal. Restriction analysis was carried out using *Sal* I, *Bam*HI, *Eco*RI, *Pst*II, and *Eco*RV. Restriction fragments were analyzed using size standards and the resulting values summed to estimate total plastid size. Gene mapping was initiated using tobacco cpDNA probes of conserved genes common to all photosynthetic organisms.

- 21 ROBESON, MICHAEL S. AND JAMES R. GAREY. Department of Biology, University of South Florida, Tampa, FL 33620 - Sequencing the *Brachionus plicatilis* mitochondrial genome.

Rotifers are a group of microscopic metazoans that are characterized by the presence of a wheel organ used for locomotion and feeding. Rotifers are important in fresh water ecosystems and are used in aquaculture as feed for larval fish. We are sequencing the mitochondrial genome of the common monogont rotifer *Brachionus plicatilis* in order to promote molecular systematic studies of rotifers. The genome is approximately 16,000 basepairs in length. We have thus far identified the NADH dehydrogenase 1, ATPase 6, 16S rRNA, cytochrome b, and 4 tRNA genes.

22

- CONNER, JENNIFER L, AND ANN E. STAPLETON. The University of Tennessee at Chattanooga - Analysis of Maize Proteins That Bind UV Lesions in DNA and the Genes That Encode Those Proteins.

Anthropogenic emissions of pollutants such as chlorofluorocarbons and halons result in stratospheric ozone depletion. As the ozone layer is reduced, increasing levels of solar UV-B radiation are reaching the earth. Damage attributed to UV-B radiation causes damage to DNA in plants. The best-studied UV radiation-induced DNA lesion is the cyclobutane-type pyrimidine dimer. However, maize plants can repair these lesions by the excision mechanism. The genes that encode excision repair have not been identified. We are screening for the proteins that specifically recognize DNA lesions by using proteins encoded by a maize cDNA library. Each cloned maize protein is expressed in bacterial cell lysates (plaques). The individual maize protein that is present in each plaque will be reacted with a DNA probe that has been heavily UV irradiated. Most of the plaques will contain a maize protein that does not bind UV lesions and will not bind to the probe. The plaques that do contain an UV binding maize protein will give a signal. These plaques contain lambda phage that have a gene for the expressed maize protein. These phage will be isolated, retested, and the gene characterized.

23

- STAPLETON, ANN E., AND HEATHER CARTWRIGHT. University of Tennessee at Chattanooga - How does corn sunburn? Physiological and genetic analysis of responses to ultraviolet radiation.

Like all living organisms, plants sense and respond to UV radiation. Some corn-growing areas are already experiencing increased levels of UV radiation as a result of stratospheric ozone depletion. Although much is understood about how plants use visible light for photosynthesis and development, much less is known about plant responses to UV radiation. The primary targets of UV radiation in plants are not known. We have found that maize seedling leaves roll longitudinally in response to UV, and we have characterized this leaf-rolling response to

ultraviolet radiation using a leaf-print assay to quantify the extent of rolling. We have also noticed that leaf surfaces have a burned, crumpled appearance after exposure to eight or more hours of UV from sunlamps. We have used the UV-induced leaf rolling response to isolate mutants (from *Mutator*-active lines) that confer sensitivity to ultraviolet radiation (leaf response to ultraviolet, *lru*). From our initial screen we have chosen one UV-sensitive mutant, *lru4*, for molecular characterization. Cloning and characterization of the *LRU* genes will allow us to understand the details of the regulation of the components of maize UV response pathways.

- 24 CARISA DAVIS AND JAMES R. GAREY. Department of Biology, University of South Florida, Tampa, FL 33620 - Molecular studies of rotifer evolutionary relationships.

There are three classes of Rotifers: Bdelloidea, Monogononta, and Seisonidea. A closely related group to the rotifers are the acanthocephalans, a group of parasitic spiny-headed worms. A comparison of morphological data of the two groups suggest that acanthocephalans are a sister taxon of rotifers, while currently available molecular data suggests that acanthocephalans are a sister group to bdelloid rotifers, making acanthocephalans a sub-taxon of Rotifera. The discrepancy between the molecular and morphological data could be due to the limited taxon sampling of the molecular studies. Only one 18S rRNA gene has been sequenced from a bdelloid rotifer (*Philodina acuticornis*). We are currently determining the sequence of the 18S rRNA gene of an additional bdelloid rotifer *Habrotrocha constricta* with the expectation that it will aid in the understanding of rotifer evolutionary relationships.

- 25 DIEHL, WALTER J.¹, COOPER, CARLTON R.², ST. CYR-COATS, KAREN¹. ¹Mississippi State University and ²University of Michigan - Natural selection in the entire primate lentiviral genome.

A paradigm of molecular evolution has been that morphology evolves by natural selection but molecules evolve mostly by neutral processes of mutation and drift. We evaluated this model using the McDonald & Kreitman (1991) analysis to test the null hypothesis that all genes in primate lentiviruses, including human immunodeficiency viruses (HIV-1, HIV-2) and several simian immunodeficiency viruses (SIV), have evolved neutrally. At least 9 of the 13 lentiviral genes showed significant adaptive fixation (selection) of amino acid-replacing nucleotide substitutions ($P < 0.01$). Some evidence suggested that 12 of 13 genes showed adaptive fixation. Minimally all genes encoding membrane proteins and enzymes, 67% of genes encoding capsid proteins, and 40% of regulatory genes showed adaptive fixation. Genes affecting morphology (*gag* capsid proteins) were no more likely to show adaptive fixation than other genes. An analysis of genes showing frequent adaptive fixation suggests that divergence of primate lentiviruses has been caused by selection acting on genes that affect cell tropism (*env* gp120 surface membrane protein) and replication (*gag* p7 nucleocapsid, *pol* reverse transcriptase). This is the first time that selection vs. neutrality has been tested independently in every gene of an organism. The results suggest that selection at the molecular level may be common.

- 26 FOSTER, STEVEN W. AND CHARLES C. SOMERVILLE. Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - Determining the phylogenetic relationships between the Northern Pike (*Esox lucius*), the Muskellunge (*Esox masquinongy*), and the Silver Pike.

Although Silver Pike are normally found in association with Northern Pike, they have distinct morphological features and have not been shown to hybridize with the Northern Pike. To date the Silver Pike has not been assigned to a distinct taxonomic unit. This study employs the use of a molecular marker on the mitochondrial genome (mtDNA) to determine the phylogenetic relationships between the Northern Pike, Silver Pike and Muskellunge. The mutation rate within mtDNA is sufficiently high to discriminate between closely related populations. PCR primers were chosen to amplify a 338 base pair hypervariable region of mtDNA. Known mitochondrial sequences from this region were compared, and were found sufficiently variable to discriminate among species within a single genus. Mitochondrial DNA was amplified from individual scales, purified using Wizard[®] Spin Columns (Promega Corp.), and submitted to the Marshall Core Facility for sequencing. The resulting sequences will be aligned using ClustalX (Thompson et al., Nuc. Acids Res. 22:4673), and phylogenetic distances and tree topologies inferred using the programs of the PHYLIP package (Felsenstein, Cladistics 5:164). The results will be used to recommend classification of the Silver Pike as either a separate species or a color variation of the Northern Pike.

- 27 NGA T. VU AND CRAIG S. HOOD. Dept. Biological Sciences, Loyola University. – Fluctuating asymmetry in mandibular form in Louisiana populations of the muskrat, *Ondatra zibethicus*

This study investigated fluctuating asymmetry (FA) in the mandibles of three Louisiana populations (Cameron, Vermilion, St. Bernard parishes) of muskrats, *Ondatra zibethicus* (n=349), using traditional and geometric morphometric methods. Seven pairs of linear bilateral measurements were taken on mandibles for the traditional FA analyses and 14 landmarks were digitized and used in the geometric morphometric approach. Linear measurements were treated following Palmer (1994), generating 2 FA indices, which were analyzed using a mixed model ANOVA (sides by individuals) to evaluate fluctuating and directional asymmetry. FA and DA were assessed using geometric morphometric methods following Smith et al. (1997). Both traditional and geometric approaches revealed no DA by sex or locality in most variables and highly significant FA in all samples. Future studies will focus on relating patterns of FA in new collections of muskrats (from these same localities) and their associated environmental data, to the historical collections. Funding was provided by a Loyola University Faculty Research Grant and sabbatical leave (to CSH) and the J.H. Mullahy Fund (to NTV).

- 28 BONNER, LISA A ¹, WALTER J. DIEHL², AND RONALD ALTIG² ¹ Dept. Biology, Peace College, Raleigh, NC 27604 and ² Dept. Biological Sciences, Mississippi State University, Mississippi State, MS 39792-Reproductive success of amphibian populations in dystrophic forest pools

Five temporary forest pools at Noxubee National Wildlife Refuge in central Mississippi were surveyed monthly for three years to gain a better understanding of the dynamics of temporary aquatic systems. These pools were chosen because of their close proximity to one another, they historically filled and dried seasonally, and they were known breeding sites for resident amphibian populations. Only 47% of the amphibian cohorts inhabiting the pools appeared to thrive and metamorphose prior to pool desiccation. Successful development and dispersal of larvae was variable among pools and years. We found that the filling cycles differed among habitats and that physicochemical and biological parameters were highly variable. Our data suggest that ephemeral pools in this central piedmont region of Mississippi are each unique and represent habitats of low predictability for amphibian breeding and success. We conclude that it is erroneous to draw generalizations regarding a "typical" temporary pool ecosystem within this region.

- 29 DOLIN, ROBIN E., BENJAMIN M. LOWMAN, JASON A. MORGAN, ANN E. SCHOOLCRAFT, AND DONALD C. TARTER. - Dept. Biological Sciences, Marshall University, Huntington, WV 25755. - Low pH tolerance of the central mudminnow, *Umbra limi*, from the Green Bottom Wildlife Management Area, West Virginia.

Low pH can have serious impacts on fish populations. It can change respiration, acid-base balance, and sodium and calcium regulation. The Green Bottom Wildlife Management Area, Cabell County, West Virginia, is a wetland complex adjacent to the Ohio River. Mudminnows are found in undisturbed clear-water areas of low gradient where the bottoms are of organic debris, muck, peat, and aquatic vegetation. Using a D-shaped dredge, 60 mudminnows were collected in the old swamp and returned to the laboratory for acclimation. Ten mudminnows were added to each of the following pH values: 2.0, 2.8, 3.4, 4.0, 6.0, 8.0 (control). Photoperiod was set at 12L:12D and water temperature was held at 25°C. After the 96-hour experiment, the median tolerance limit (T_{lm}) was calculated using the straight line graphical interpolation method. The 96 hour T_{lm} pH value was 3.4, showing that the central mudminnow is extremely tolerant to acid stress. Results will be compared to other laboratory studies involving low pH tolerance values in fishes.

- 30 PAULEY, THOMAS K., ANDREW LONGENECKER, BRIAN LINDLEY, JAYME WALDRON, AND SANDY RAIMONDO, Dept. Biological Sciences, Marshall University, Huntington WV 25755 - Potential impacts on forest salamanders from multiple applications of insecticides.

A long-term study analyzing potential impacts of gypsy moth pesticides on forest salamanders began in 1995. Nine plots were used in the study, three of which were treated with Gypchek, 3 were treated with

BT and 3 were Controls. Marking the fourth year of the study and the second post-treatment year, 1998 data were used to compare biodiversity of terrestrial and aquatic salamanders, environmental parameters, dietary composition, reproductive potential and stored energy between treatment plots. Terrestrial salamanders were surveyed using cover boards, point survey and night survey methods. Aquatic salamanders were surveyed by juvenile refugia bags, stream survey and night survey methods. A total of 705 salamanders was collected in 1998. The month in which the most salamanders were collected was May and the method by which most were collected was stream surveys. Salamander data collected in 1998 were also compared to those collected the previous years. In addition to the salamander study, impacts of the gypsy moth pesticides on birds and insects are being studied. The entire project is funded by the US Department of Agriculture.

- 31 O'CONNELL, ANN M. (UZEE)¹ AND PAUL L. ANGERMEIER². ¹Gulf Coast Research Laboratory Museum, Ocean Springs, MS 39566 and ²Virginia Cooperative Fish and Wildlife Research Unit, Virginia Polytechnic Institute and State University, Blacksburg, VA 24060-0321 - Habitat relationships for alewife and blueback herring in a Virginia stream.

We examined associations between habitat variables and occurrence and density of alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) adult and two early egg stages in a tributary of the Rappahannock River, Virginia from February-May 1992. Associations between tidal condition, time of day, light intensity, and temperature and peaks in densities of river herring life stages were determined by plotting environmental variables and herring densities against time. Logistic regression was used to determine which habitat variables were good predictors of occurrence of river herring life stages. Peaks in densities of alewife eggs and blueback herring adults were positively associated with peaks in water temperature (within the ranges of 4-19°C and 14-22°C, respectively). Occurrences of alewife early egg stages were positively related to dissolved oxygen (7-12 ppm) and velocity (3-20 cm/s). Occurrences of blueback herring adults and early egg stages were positively related to water temperature (14-22°C). The temperature range over which blueback herring spawned in our study was similar to that observed in other parts of its range.

- 32 BRZOSTOWSKI, LISA and MARK MEADE. Department of Biology, Jacksonville State University, Jacksonville, AL 36265 - Phylogenetic relationship among African Cichlids, *Oreochromis* spp.

On an evolutionary scale, the African Cichlids comprise some of the oldest fish species known. Historical records confirm that many Tilapia species have been exploited and used for human consumption for centuries. Tilapia were first introduced to the United States in the late 1950's and are now indigenous to southern California and Florida. Because Tilapia species commonly interbreed, there is some concern over loss of genetic diversity among modern species. The purpose of this study was to examine genetic diversity in four Tilapia species that have presumably been maintained reproductively isolated. Tissue samples from four species of Tilapia fry, *Oreochromis niloticus*, *O. aurea*, *O. mossambicus*, and *O. honorum*, were examined using electrophoresis techniques. Tissues were examined for total proteins, isozymes, and DNA using standard protocols. Preliminary analysis suggests that these four species are more similar than anticipated indicating that inbreeding has resulted in the loss of genetic diversity. However, highly conserved protein groups, such as muscle parvalbumins, have remained genetically diverse and may serve as species-specific markers. Compiled genetic diversity indices are currently being calculated.

- 33 MENHINICK, EDWARD F.¹ AND ANTHONY J. ROUX². ¹Dept. Biology, University of North Carolina at Charlotte, Charlotte, NC 28223, and ²Mecklenburg County Department of Environmental Protection, Charlotte NC 28202. - Fishes and water quality of Mecklenburg county.

Comparisons of fish collections of streams made prior to 1980 with those made in the 1990's reveal many changes in the distribution of fishes in Mecklenburg County. More stringent water quality regulations have resulted in repopulation of fishes previously absent from several streams. On the other hand, urban and residential development has increased siltation, flooding, and pollution of other streams and has resulted in

extirpation of several species. Water quality measurements including 30 element ICP analyses have been made for most 1990 stream locations and provide information on types and potential sources of pollutants and their effects on fishes.

- 34 MENHINICK, EDWARD F. AND STEVE CLARK. Dept. Biology, University of North Carolina at Charlotte, Charlotte, NC 28223. - Use of Microsoft ACCESS for the computerization of museum records.

The 2000 fish collections of UNCC have been computerized with a specially designed Microsoft ACCESS data base. The database is fully relational and is organized to reduce redundancy and data entry errors. It is organized into a "block data" table that includes genus-species abbreviation, complete name for genus and species, family number for phylogenetic sequencing, and family name. The "fishdata" table lists location, collector, and date. The "species" table contains the species-genus abbreviation, number collected, disposition, catalogue number, and notes. Primary keys are used to define relationships between the records in the three tables. These keys include collection number for the "fishdata" and "species" tables; and the genus-species abbreviation joins "block data" to the "species" table. New collections are catalogued via a collection "data entry" form that transfers information to the above three tables. It consists of a "main form" containing collection number, location information, collectors, and date, and a "subform" that contains species information. The three tables are joined to enforce referential integrity, i.e., when a given field is changed, all related records are also updated. Records may be sorted and grouped in any manner desired. Custom parameter queries permit the display of only specific information. i.e., records from a particular drainage, year, family, or only those housed in the museum. UNCC is using three custom reports: Collection format: A printout of each individual collection, Taxonomic format: A printout arranged by species along with associated collection data, Label format: A printout of labels for each species with an "M" disposition (museum) printed with indelible ink on 100% rag paper for insertion in the preservative with the specimens.

- 35 HARVEY, MARGARET C.¹, GERTRUDE W. HINSCH¹, AND DON F. CAMERON². ¹Dept. of Biology, University of South Florida, Tampa, FL 33620 and ²Dept. of Anatomy, College of Medicine, University of South Florida, Tampa, FL 33612-Stage-related changes in the distribution of junction-related cytoskeletal proteins in the crayfish testis.

The results of a lanthanum tracer study indicate the presence of an occluding junction between adjacent Sertoli cells in the germinal epithelium of the crayfish, *Procambarus paeninsulanus*. The appearance of such junctions is coincident with the appearance of late (stage VI) spermatids and the formation of a lumen. Extensive pleated septate junctions first appear during late spermiogenesis, although it remains unclear at this time if the barrier is constructed solely of these septate junctions or if a tight junction (*zonula occludens*) is disposed in a more apical position. The presence of the junction-associated cytoskeletal proteins alpha-actinin and vinculin has been determined by indirect immunofluorescence microscopy. Stage-related changes in the localization of these proteins were observed. Future work will be directed toward identifying alpha-actinin and vinculin at the ultrastructural level by immunogold staining and also testing for the presence of various transmembrane and peripherally-associated junctional proteins (cadherins, ZO-1, ZO-2) by Western blotting and immunostaining.

- 36 MENHINICK EDWARD F. AND MARGARET M. SCHAEN. Dept. Biology, University of North Carolina at Charlotte, Charlotte, NC 28223. - Structure of the gills and the food grooves of freshwater clams.

Paraffin embedded histological sections stained with hematoxylin-eosin, and scanning electron microscope photographs were made of the gills of freshwater clams. Asiatic clams, fingernail clams, and several species of unionid mussels exhibited wide differences in the structure of water tubes, septae, and food grooves. These differences may be used to assess affinities between different taxa, and to study methods of feeding and transfer of food by the gills.

- 37 FOSTER, TOBY¹, IRENE KOKKALA¹, KAREN MCGLOTHLIN², KERRY PAYNE¹ and ROWENA HARRIS¹. ¹Dept. of Biology, North Georgia College & State University, Dahlonega, GA 30597 and ²Dept. of Biology, The University of the South, Seawee, TN 37383 - A preliminary survey of terrestrial tardigrades from Glade Shoals, GA.

A preliminary survey on terrestrial tardigrade populations at Glade Shoals, GA was conducted. Glade Shoals is a ridge characterized by unshaded granite rock outcrops and is located in Hall County in Northeastern Georgia. Lichen specimens from eighteen randomly selected stations on rock outcrops were collected and stored in paper bags. Seven species of lichens, three foliose and four fruticose, were included in the samples. Dried samples were rehydrated, tardigrades were extracted, and mounted using Hoyer's medium on glass slides for identification. A total of 326+ tardigrades have been identified comprising one class and at least four genera, including *Macrobiotus*, *Minibiotus*, *Milnesium*, and *Diphyscon*. The class Heterotardigrada is not represented in our samples so far. *Minibiotus* is the most abundant species. Overall the distribution of the tardigrades does not appear to be correlated to the lichen growth form, lichen species, or to the abundance of other tardigrade genera.

- 38 CORNWELL, KACY¹, DENNIS C. HANEY¹, STEPHEN J. WALSH², AND ELISABETH GILLIARD¹. ¹Department of Biology, Furman University, Greenville SC 29613 and ²United States Geological Survey, Florida Caribbean Science Center, Gainesville, FL 32653 - The influence of salinity and temperature on the physiology of the teleost, *Limia melanotata*.

We investigated how salinity and temperature affected routine metabolic rate (RMR), temperature tolerance (CTM, critical thermal maximum), and salinity tolerance of *Limia melanotata*, a poeciliid fish that occurs in freshwater habitats of Hispaniola. RMR and CTM were measured in fish acclimated to three salinities (0, 30, and 60 ppt) and three temperatures (25, 30, and 35°C), for nine temperature/salinity combinations. RMR was constant in fish at 25°C and 30°C at salinities of 0 and 30 ppt, but declined significantly at 60 ppt. In the 35°C group, metabolic rate decreased significantly from 0 to 30 ppt and again from 30 to 60 ppt. Mean RMR in 0 ppt was highest at 35°C, intermediate in fish acclimated to 30°C, and lowest at 25°C. However, at 30 and 60 ppt, RMR in fishes acclimated to 30 and 35°C were not significantly different, although both were higher than 25°C acclimated fish. Lower RMR at higher salinities and temperatures is probably due to their combined effect on oxygen availability. Fish acclimated to 30°C had significantly greater mean CTM than 25°C fish, but were not different from 35°C fish. These results may suggest that *L. melanotata* reduce energy expenditures at environmental extremes in order to tolerate these environments for longer time periods. In a separate experiment, *L. melanotata* exposed to chronically increasing salinities survived to 67 ppt, with most mortality from 85-105 ppt, thus demonstrating remarkable salinity tolerance comparable to some other cyprinodontoids.

- 39 RABON, DAVID R., JR.¹, WM. DAVID WEBSTER¹, and D. KIM SAWREY². ¹Dept. Biological Sciences and ²Dept. Psychology, University of North Carolina at Wilmington, Wilmington, NC 28403 - Comparison of infant ultrasonic vocalizations and parental response in the montane vole, *Microtus montanus*, and the prairie vole, *M. ochrogaster*.

The young of many rodent species produce ultrasonic vocalizations when separated from conspecifics. Researchers have suggested that the production of ultrasounds by isolated pups may elicit a retrieval response from the parent. For this study we examined the parental response to infant ultrasounds in two species of *Microtus* that exhibit different social systems, the montane vole (*M. montanus*) and the prairie vole (*M. ochrogaster*). We reunited a parent and its pup, age 0-14 days postpartum, and recorded ultrasounds for three minutes for each species. We also recorded the parent's latency to approach, contact, and retrieve the pup. Infant prairie voles emitted a greater number of ultrasounds (mean = 180.5) in the presence of a parent than did infant montane voles (mean = 14.5). Parental response to infant ultrasounds occurred more quickly when pups were younger (< 9 days postpartum) in prairie voles. In montane voles, however, quicker parental response occurred when pups were older (> 9 days postpartum). Infant montane voles and prairie voles typically were approached, contacted, and retrieved more rapidly by the dam than by the sire. Forty-seven percent (14 of 30) of infant prairie voles attached to the dam's teat, whereas infant montane voles never attached.

- 40 BERNSTEIN, MARICA, AND HAL DANIEL. East Carolina University, Greenville, NC. - Middle ear anatomy of voles with differing parenting and vocalization behaviors (*Microtus ochrogaster* and *M. pennsylvanicus*).

The prairie vole (*Microtus ochrogaster*) is one of fewer than three percent of monogamous mammalian species. Prairie voles live in family groups that include neonates, parents, and juvenile siblings, all of whom participate in caring for infants. A related but polygamous species is the solitary meadow vole, *M. pennsylvanicus*. Only the female provides parental care, and to a significantly lesser degree than the female prairie vole. Pup vocalizations differ between the two species. Both emit vocalizations in the ultrasonic (US) frequency range, but prairie vole pups emit ten times the number of US calls and those calls have a definite structure lacking in meadow vole pups. Implicit in all hypotheses that attempt to explain the 'function' of the prairie vole pups' vocalizations is the assumption that prairie voles 'hear' the US vocalizations (while meadow voles may not). If this is correct, the morphology of the species' middle ears may also differ: the prairie vole middle ear being tuned to receive higher frequency calls. The bulla houses the middle ear cavity structures and collectively these structures (ossicles, tympanic membrane, muscles) act as a mechanical transducer of acoustic energy to hydraulic energy, matching the impedance of air to that of the fluid-filled inner ear. There are known relationships, based on the properties of sound, between frequency reception and specific structures of the middle ear cavity. Here I report on interspecies and sexual dimorphisms in bulla to skull ratio, inter-bullae distance, tympanic membrane area, and linear measures of the ossicles. I comment briefly on the implications of these data in understanding the two species' parenting and vocalization behaviors.

- 41 CONNER, JENNIFER L., JARON J BERGIN, AND HENRY G. SPRATT, Jr. Biodegradation of Waste Crankcase Oil in Laboratory Mesocosms. University of Tennessee at Chattanooga.

Microbial degradation of waste crankcase oil was monitored in mesocosms amended with an oil degrading bacterial culture and time-release nutrient fertilizer. The mesocosms were constructed from 10-gallon aquaria, with approximately 28,000cc of soil added. Treatments included the addition the bacterial culture in one mesocosm, and the addition of culture and time-release fertilizer to another. A third mesocosm served as a control. Batch cultures of the organism were observed to verify the culture's oil degrading nature. Hexane extraction was performed on all samples, and degradation rates of oil were determined on a percent weight loss basis. Preliminary data indicates a 40% reduction of oil in batch cultures over 4 weeks. A 20-30% reduction of added oil in soil mesocosms was observed over the experimental period. There was no significant difference in loss of oil among nutrient amended and non-amended mesocosms. Additional studies will be conducted in order to verify these results.

- 42 SAFFORE, LATEEF Y., AND CHARLES C. SOMERVILLE. Dept. Biological Sciences, Marshall University, Huntington, WV 25755-Identification of coliform-like bacteria isolated on eosin methylene blue agar.

The presence of *Escherichia coli* or similar enteric bacteria (coliforms) in the environment implies recent fecal contamination from human or animal sources. The extent of such contamination is used to make important decisions regarding the appropriate use of water resources. Water quality tests are designed for rapid detection of coliforms, but the methods must also reliably differentiate intestinal bacteria from environmental strains if appropriate resource-use decisions are to be made. In this study water samples were collected from several sites near Huntington, WV, plated directly on Eosin Methylene Blue (EMB) Agar (Difco Labs) and incubated at 37°C overnight. Colonies that displayed a green metallic sheen by reflected light, a characteristic of *E. coli*, were picked and struck for isolation. Each isolate was then identified using a standardized battery of 95 metabolic tests (Biolog, Inc.). Of twenty presumptive *E. coli* isolates only one was actually identified as *E. coli*. The remaining isolates were placed in five genera: *Acetobacter*, *Enterobacter*, *Klebsiella*, *Pseudomonas*, and *Yersinia*. This study demonstrates the problems inherent in identifying bacteria based upon a few key characteristics, and indicates that classical water quality tests can easily overestimate the abundance of enteric organisms in the environment.

- 43 MECHAM, JOHN A., CATHERINE VOGL, JESSICA TOLBERT, AND PATRICIA ALLISON. Biology Department, Catawba College, Salisbury, NC 28144 - Immunostimulatory effects of murine interferon- γ and interleukin-12 on *Schistosoma mansoni*.

Schistosomiasis is a parasitic disease which infects over 300 million people. The infection down-regulates the immune response from Th1 mediated immunity, or cell-mediated immunity, to Th2 mediated immunity, or antibody immunity. The cytokines, interferon- γ (IFN- γ) and interleukin-12 (IL-12) are known to upregulate the immune response by limiting Th2 cell proliferation. The main purpose of this research was to determine the efficacy of treating mice with murine IFN- γ in tandem with IL-12 prior to and during infection with *Schistosoma mansoni*. Egg and worm burdens were obtained upon necropsy and peripheral T-lymphocytes were quantified. Reduced egg counts and worm burdens and increased T-cell levels were observed in cytokine treated mice vs. controls. Also, the cytokines had an additive effect.

- 44 O'CONNELL, MARTIN T.¹ AND RICHARD J. NEVES². ¹University of Southern Mississippi and ²Virginia Polytechnic Institute and State University - Immunoelectrophoretic analysis of the immunological responses of host and non-host fishes to glochidia and juveniles of a freshwater mussel.

The larval forms (glochidia) of most freshwater mussel species are obligate parasites on specific host fish species. Because non-host fishes reject glochidia with immune responses, it is likely that host specificity is determined by immunological factors. Immunoelectrophoresis was used to test if host and non-host fishes expressed different immunological responses when infested with glochidia. Sera from host and non-host fishes were tested against antigen solutions prepared from glochidia and juveniles of the rainbow mussel (*Villosa iris*). In trials separating serum components and trials separating glochidial antigens, both host and non-host fishes produced compounds that reacted with glochidial antigens. Electrophoretically separated sera from the host rock bass (*Ambloplites rupestris*) differed from non-host sera in that 11 of 17 samples exhibited precipitation bands (positive reaction) in the far beta region of the gel. None of the 37 non-host samples exhibited precipitation bands in the far beta region. In trials separating glochidial antigens, the only notable difference between host and non-host fishes was that sera from 3 non-host goldfish (*Carassius auratus*) exhibited 'double bands' when exposed to electrophoretically separated glochidial antigens. No other samples exhibited 'double bands'. When antigen solutions prepared from glochidia and juveniles were electrophoretically separated, none of the 51 samples of juvenile antigens exhibited precipitation bands. These results suggest that there are differences between host and non-host fishes in regard to immunological responses to glochidial infestation.

- 45 SHERIDAN, PHILIP^{1&2} AND WILLIAM SCHOLL¹. ¹Meadowview Research Station, Woodford, VA and ²Dept. of Biol. Sciences, Old Dominion Univ., Norfolk, VA - *Sarracenia purpurea* L. ssp. *venosa* (Raf.) Wherry var. *burkii* Schnell (green) new to Florida.

Sarracenia pitcher plants are known for both their carnivorous habit and brightly colored leaves. Wild-type individuals normally contain anthocyanin pigments in flowers and/or leaves. Plants which completely lack anthocyanin have been found in several populations of pitcher plant species in the Gulf Coast. This anthocyanin deficiency is caused by a recessive allele (green) involved in a biochemical step between leucocyanidin and pseudobase. Wild-type leaf extracts in acidified methanol turn red whereas the mutant remains unchanged. Confirmation of the mutant can be performed by boiling the methanolic extract in 4N HCL and observing a red solution. We hypothesized that investigation of western Florida pitcher plant bogs would result in the discovery of this plant. Searches by the junior author during 1998 in a Liberty County, Florida *S. purpurea* ssp. *venosa* var. *burkii* population resulted in the discovery of several individuals of this rare mutant. This discovery represents an addition to the flora of Florida.

- 46 PAULEY, ERIC F., BARBARA DIETSCH, AND RON E. CHICONE, JR. Dept. Biology, Coastal Carolina University, Conway, SC 29528 – Survival, growth, and vegetation associations of the threatened *Amaranthus pumilus* (seabeach amaranth) on a South Carolina barrier island.

Populations of the federally threatened annual herb *Amaranthus pumilus* (seabeach amaranth) have been reduced by human activities in its natural dune habitat along the Atlantic coast. Regional-scale surveys have shown that abundances vary greatly from year to year. However, few data on within-season demographics, growth, and vegetation relationships of this species exist. We monitored a small population on an undisturbed barrier island near Myrtle Beach, South Carolina. Although an earlier survey on the island found 13 individuals, we found 66 individuals in a different location. Plants disappearing soonest were typically small, but size was not a good predictor of overall survival. Plants seen only once comprised 29% of plants and averaged 1.0cm long. However, plants surviving at least 58 days (41%) averaged only 2.0cm long. Consequently, size distributions changed little over time, with >75% of individuals remaining small (<5cm stem length) and only a few growing up to 18cm long. Plant size often decreased between census dates, due to shifting sand and/or animal grazing. We estimated cover of other species in plots both randomly located and centered on each *Amaranthus*. Simple comparisons and ordination of all plots both indicated that *Amaranthus* is negatively associated with many of the dominant species (*Uniola*, *Panicum*). These data support the view of this species' "fugitive" strategy, but they also suggest that the plant is easily overlooked and more abundant than suspected.

- 47 STEPHENSON, STEVEN L.¹, HAROLD S. ADAMS², DAVID M. LAWRENCE³, JAMES S. RENTCH⁴, ROBERT B. COXE⁵, MARTIN SCHNITTTLER¹, MOLLY J. PRESTON² AND HEATHER M. ROBERTSON¹. ¹Dept. Biology, Fairmont State College, Fairmont, WV 26554, ²Div. Arts and Science, Dabney S. Lancaster Community College, Clifton Forge, VA 24422, ³9272-G Hanover Crossing Drive, Mechanicsville, VA 23116, ⁴Div. Forestry, West Virginia University, Morgantown, WV 26505, and ⁵Biota of North America Program, UNC-CH, Chapel Hill, NC 27599 - Forests along the Blue Ridge Parkway south of Roanoke in southwestern Virginia.

Quantitative data on the composition and structure of the tree (stems ≥ 10 cm DBH) and small tree (stems <10 but ≥ 2.5 cm DBH) strata were collected from forest communities at ten localities along the Blue Ridge Parkway between Roanoke and Rocky Knob in southwestern Virginia. Few studies have considered the forests of this portion of the southern Blue Ridge. Forest types sampled ranged from a Virginia pine (*Pinus virginiana*) community on a xeric, low elevation site to mixed oak (with *Quercus rubra* and *Q. prinus* the most important species of oak present), tulip poplar (*Liriodendron tulipifera*), and white pine (*Pinus strobus*) communities on more mesic upland sites. Of particular interest was a Carolina hemlock (*Tsuga caroliniana*) community located on a steep, north-facing slope. Red maple (*Acer rubrum*) was consistently present as a canopy associate in most of the communities sampled, with black gum (*Nyssa sylvatica*), sourwood (*Oxydendrum arboreum*), black locust (*Robinia pseudoacacia*), and pignut hickory (*Carya glabra*) also important in some situations.

- 48 HALDEMAN, JANICE H. Department of Biology, Erskine College, Due West SC 29639. - Flowering, fruiting, and germination dynamics of Pink Lady Slippers, (*Cypripedium acaule*) in Greenville County, SC.

This poster presents preliminary findings from a 3-year, multi-faceted study of a localized deme of >1200 Pink Lady Slippers (*Cypripedium acaule*) located in an oak-hickory-pine woodlot in South Carolina's piedmont. A flowering study revealed that while the number of plants remained relatively steady, the number of blossoms nearly doubled each year, from 89 in 1996 to 244 in 1998. This trend of increasing bloom rate coincided with, and was perhaps related to, a decreasing trend in canopy coverage due to beetle-induced reduction of the pine overstory. A fruit-set study determined that with few exceptions, fruiting occurred only on hand-pollinated plants. Finally, a germination study, in which seeds from refrigerated fruits were germinated *in vitro* at 4, 6 and 8 months post-harvest revealed that seeds from all groups germinated best when media were amended with 0.5 milligrams per liter of kinetin.

- 49 MORRIS, ASHLEY B. AND MITCH CRUZAN. Dept. of Botany, University of Tennessee, Knoxville, TN - Genetic variation in the *Fagus grandifolia* complex.

Phylogeographic studies may yield detailed information regarding gene flow, population history, and dispersal patterns of the organisms in question. Molecular data can be more informative in determining phylogenetic relationships within and between taxa than traditional morphological data that may be environmentally variable. Since there is a large degree of morphological variation within and between populations of *Fagus grandifolia*, this species makes an excellent case study for phylogeographic investigation. I will use hypervariable regions of the chloroplast DNA genome to determine patterns of relatedness within the *Fagus grandifolia* complex. A second goal of this work will be to investigate ratios of sexual versus asexual reproduction in *Fagus grandifolia* populations in GSMNP by using hypervariable genetic markers (AFLPs). Asexual reproduction by root sprouting is suspected to be an important process in the maintenance of beech populations under relatively severe environmental conditions. It is not known how long root sprouts remain connected to the parent tree root system, and studies that focus on current connections between individuals may be ignoring other individuals of root sprout origin.

- 50 SUCHECKI, PAUL F. AND PHILIP A. ROBERTSON. Dept. Plant Biology, Southern Illinois University at Carbondale - Vegetation analysis and succession at LaRue Pine Hills Research Natural Area, Union County, Illinois.

Vegetation and environmental data were obtained in 114 permanent 0.04 ha circular plots at LaRue Pine Hills RNA. Six dominance types based on basal area were identified using COMPAH. These included *Pinus echinata*/*Quercus velutina*, *Q. velutina*, *Quercus alba* and *Quercus rubra*. Site characteristics measured were slope aspect, position, angle, elevation, terrain shape, landform and topographic shading indices. The *P. echinata*/*Q. velutina* type occurred almost exclusively on south facing upper slopes. The *Q. velutina* type occurred on ridgetop, north upper and south middle slopes. The *Q. alba* type occurred on the greatest variety of sites types. The *Q. rubra* type occurred almost exclusively on north lower slope sites. Density by size class was calculated for each overstory species to predict potential future species composition. The *P. echinata*/*Q. velutina* type was dominated by *P. echinata* in the larger classes and *Q. velutina* in the smaller classes. In the *Q. velutina* type, *Q. velutina* was dominant in all but the smallest class. In the *Q. alba* type, *Q. alba* was dominant or highly abundant in all size classes. In the *Q. rubra* type, the smallest size class was strongly dominated by *Acer saccharum*. This research was funded by the U. S. Forest Service.

- 51 JAMES, MARY M. Curriculum in Ecology, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599-3275 - Patterns of legume distribution in the Carolina sandhills.

Legumes are an important group of plants in the frequently-burned longleaf pine-wiregrass ecosystem. Nearly fifty species of legumes occupy a variety of site conditions in the Sandhills region of the inner Atlantic Coastal Plain. The region is generally believed to represent the xeric extreme of the range of the longleaf forest where soil moisture is a strong determinant of vegetation. Within the upland soils of the Sandhills small, shallow, irregularly-shaped depressions, locally known as "bean dips," are present. These depressions support a large number of legume species and individuals compared to the surrounding topography. Dry upper troughs of streamheads known as "pea swales" exhibit a similarly striking contrast. In North and South Carolina, twenty transects were established in bean dips and pea swales in the direction of maximum slope. Stem density by legume species was evaluated along this complex gradient using 0.5 m. quadrats. Preliminary findings indicate strong patterns in species turnover, with species richness and abundance generally decreasing toward the periphery of the depression. Soil texture and slope appear to be the primary factors driving these patterns.

- 52 DILUSTRO, JOHN J. and FRANK P. DAY. Old Dominion University, Norfolk, VA 23529 - Substrate and microenvironmental effects of elevated carbon dioxide on root decomposition.

The analysis of root decomposition under elevated carbon dioxide is critical to understanding soil carbon dynamics. We measured the effects of elevated carbon dioxide on the decomposition rates of roots grown in ambient and elevated carbon dioxide during a previous pilot study. We used open top chambers with both

ambient and elevated (700 ppm) CO₂ treatments in an oak-palmetto scrub ecosystem at Kennedy Space Center, Florida. Vertical litterbags were installed in September 1996 in each elevated and control chamber to allow comparison of decomposition rates. Initially samples were harvested every three months. Fine root decomposition rates have been obtained from root litterbags retrieved from December 1996 to September 1997. Results to date show no significant treatment effect on root decomposition in the top 10-cm of soil. Initial percent mass loss varied from 10.3% to 13.5% after three months; 29% to 40% of original mass has been lost after 12 months. Several studies have measured changes in root biomass under elevated atmospheric CO₂ levels predicted for the middle of the next century. The decomposition rates of fine roots control the rate of carbon input into the soil.

- 53 COOPER, AARON, LARISSA KNEBEL, AND J. DAN PITILLO. Department of Biology, Western Carolina University. A predictive model of the changes in herbaceous cover in hemlock forests of the Great Smoky Mountains National Park.

Forty six plots with various distinct community types dominated by eastern hemlock (*Tsuga canadensis*) were established in the Cataloochee watershed in the eastern portion of the Great Smoky Mountains National Park. These plots followed the North Carolina Vegetational Survey protocol. Twenty of these plots were previously established by Frank Miller in the early to mid 1930s. With the impending invasion of the hemlock woolly adelgid (*Adelges tsugae*), a full characterization of hemlock forests is crucial in creating a predictive model for these communities. The herb layer consists mostly of members of Ericaceae. The dense understory of *Rhododendron* and the acidic nature of hemlock forests account for the low species diversity in the herbaceous layer. Presently hemlock forests comprise one percent of the entire park. With the arrival of the adelgids and subsequent elimination of hemlocks over the next decade, canopy gaps will allow succession and consequently changes in community structure. One possibility is that in those plots with existing dense *Rhododendron* cover, species diversity will remain low. In those plots where *Rhododendron* is less prominent (approximately 30% of the study plots), the change in community structure is more difficult to predict. Herbaceous data, elevation, soils, aspect, and various other parameters will be used to predict the changes in community structure resulting from hemlock death. Furthermore, ordination techniques will be used to predict the divergence in community types.

- 54 WEBBEKING, AMY L. AND SCOTT B. FRANKLIN, University of Memphis, Memphis, TN 38152 - Vegetative Re-Growth of Kudzu Pond following Transline Herbicidal Treatment of *Pueraria montana*

Abstract: *Pueraria montana* (Lour.) Merr. var. *lobata* (Willd.) Maesen & Almeida, commonly known as Kudzu, is an invasive alien vine that has competitively displaced thousands of acres of farmland and native vegetation mostly in southern areas of the United States. Our study aimed to analyze vegetative re-growth of a slope following herbicidal treatment of Kudzu and patterns of vegetative similarity between a Kudzu slope, a second-growth forest slope, and an untreated Kudzu slope. We took ½ m² vegetative samples from stakes placed at five meter intervals along four transects running perpendicular to slope contour. Transects were placed 15m apart at each of the three sites. The change between pre and post herbicide herbaceous flora cover was examined. Application of *Transline* herbicide was shown to significantly alter herbaceous dominance by Kudzu. We expect an invasive mode of re-colonization of the slope due to the depleted seed/rhizome bank biomass found under the Kudzu monoculture in comparison to that found under adjacent old field vegetation. Our results emphasize the negative impact of Kudzu and describe preliminary spatial patterns of re-growth following treatment.

- 55 RODGERS, H. LEROY and FRANK P. DAY. Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529 - A comparison of fine root dynamics in naturally-recovering and restored Atlantic white cedar swamps.

Success of ecologically-based conservation and restoration of Atlantic white cedar (*Chamaecyparis thyoides*) swamps requires quantitative assessments of their structure and function. Fine root dynamics play an important and little-studied role in organic matter production and accumulation in forested wetlands. Using minirhizotrons, fine root dynamics are being quantified for naturally-recovering stands (mature, intermediate, and young age classes) and for three planted restoration sites in southeastern Virginia and northeastern North

Carolina. Fine roots are sampled on 45-day intervals (beginning 5 July 1998) to a depth of 64 cm. Other measurements related to production, carbon cycling, vegetation dynamics, hydrology, and edaphic parameters are being taken in conjunction with root measurements. Root length densities (RLD) changed little in the mature and intermediate sites but increased in the young and restoration sites during the initial 90-day sampling period. By 28 September, RLD for the entire depth profile was similar across all sites (1.9 to 2.5 mm/cm²). Analysis of RLD with depth showed that mean RLD was similar across all sites for the 1-20 cm and 21-40 cm depth classes, but young and restoration sites exhibited lower RLD at the 41-64 cm depth class. Mean fine root diameter was 0.35, 0.34, 0.35, and 0.20 mm for the mature, intermediate, young, and restoration sites, respectively.

- 56 THOMPSON, RALPH L., CHRIS A. FLEMING, AMANDA N. ALLEN¹, W. NEAL DENTON², AND JOHNNY R. SKEESE³. ¹Biology Department, Berea College, Berea, KY 40404, ²Plant and Soil Science Department, University of Tennessee, Knoxville, TN 37950, and ³Pharmacy Department, University of Toledo, Toledo, OH 43606 - Vascular flora and plant communities of The John B. Stephenson Memorial Forest State Nature Preserve, Rockcastle County, Kentucky.

A descriptive study of the flora and vegetation was conducted during 1997 at the 35th Kentucky State Nature Preserve, The John B. Stephenson Memorial Forest of Berea College (i.e. Anglin Falls Ravine), a 52.0-ha natural tract of Mixed Mesophytic Forest within the Johnetta Geological Quadrangle in northeastern Rockcastle County. This site lies at the northernmost part of the Northern Cumberland Plateau of the Appalachian Plateaus Province. Lithology within the Preserve includes Pennsylvanian conglomeratic sandstones and Mississippian siltstones, limestones, and shales. Topographic relief ranges from 457 m at Anglin Falls, an intermittent waterfall of 23.1 m, to 335 m at the union of Anglin Creek with Anglin Fork Road. Vascular flora consists of 99 families, 311 genera, and 540 taxa, of which 54 (10.2%) are exotics. Taxa consist of Lycopodiophyta (4), Polypodiophyta (29), Pinophyta (4), and Magnoliophyta (451). Largest families are the Asteraceae (71), Poaceae (50), Cyperaceae (36), Fabaceae (23) and Lamiaceae (20). *Panax quinquefolius*, *Hydrastis canadensis*, and *Synandra hispidula* are special concern taxa monitored by the Kentucky State Nature Preserves Commission (KSNPC). Seven forest plant communities are described from point-quarter sampling (812 points; 3248 canopy trees): *Platanus-Liriodendron*; *Quercus alba-Carya-Acer*; *Liriodendron-Acer saccharum-Quercus-Carya-Fagus*; *Quercus prinus-Pinus virginiana-Acer rubrum*; *Pinus virginiana-Liriodendron*; *Liriodendron-Acer saccharum-Fagus*; and *Quercus-Acer-Liriodendron-Tsuga*. Ruderal plant communities exist in disturbed habitats without a permanent forest structure. High species richness and diverse habitats of the Mixed Mesophytic Forest and ruderal communities in the Preserve have resulted from interrelations between climate, soils, substrates, topographic terrain, existing vegetation, and disturbance features.

- 57 SCHENING, MICHAEL R. AND CLIFF HUPP. U.S. Geological Survey, Reston, VA 20192 - Landform attributes, soil moisture and forest composition in the Central Appalachians.

The physical attributes of landforms influence drainage pathways, moisture availability and thus, the form and composition of forests. We investigated forest composition, soil moisture, and physical attributes of landform types in the Valley and Ridge of northwestern Virginia. Landforms were categorized, based on slope shape, as nose, side slope, cove or alluvium. These landforms are believed to represent a gradient of increasing runoff and available moisture. Woody species density, basal area and percent canopy, shrub and herb cover were determined for plots (400 m²) on all four landforms. Elevation, declivity, aspect and colluvial cover (stones >25cm) also were determined. Soil moisture was periodically measured at each plot from February 1997 through November 1998. Associations between landform and vegetation data were determined by DCA. Landform (nose/cove) had little effect on soil temperatures, while plots with a south and west aspect were warmer than those with a north and east aspect. Soil moisture was unaffected by either aspect or landform prior to the onset of canopy transpiration. However, landform and aspect were associated with the depletion of soil moisture during canopy transpiration, resulting in a decreasing moisture gradient from coves to noses. Analysis of vegetation data suggest a corresponding continuum of species from mesic coves to dry nose plots.

- 58 MADSEN, DANA L. AND JOAN L. WALKER. USDA Forest Service, Clemson, SC - Effects of time since fire and site on seed production in *Macbridea alba*, a rare mint.

We investigated components of seed production in relation to fire history and site in *Macbridea alba*, a threatened mint of fire-maintained flatwoods in Florida. Six sites in the Apalachicola National Forest were burned spring 1993 or 1994 and sampled summer 1994. We measured seed output (seeds/plant) and components: stem length, and number of stems, inflorescences, and flowers/inflorescence. We used ANOVA to determine burn time and site effects, and path analysis to model relationships among

components. Fire influenced seed output and all components except seeds/flower. Compared to 1993 burned plants, 1994 plants were smaller with fewer inflorescences and flowers, and lower seed output, but more flowers/inflorescence. Site affected only seeds/flower and seed output. Path analysis illustrated the direct effects of seeds/flower and flower number on seed output and indirect effects of other components on seed output through flower number. We suggest that spring fire limits seed production by removing developing flower meristems. That seeds/flower was low (< 1) at all sites suggests a limiting factor that acts independently of fire and site.

- 59 MCKENNA, MARY, COREY PALMER, DEADREA FONTAINE AND ANDREA WOODS. Department of Biology, Howard University, Washington, D.C. 20059. - Variation in pollen response to pH. Does it reflect differences in the acidity of the environment?

In previous studies with a variety of western plants, we found that most species demonstrate maximal germination and tube growth at pH 5.5 and show a significant decline in germination below pH 4.5. Average rainfall pH in the western U.S. is greater than pH 5.3 however, which is much higher than average rainfall pH in the northeastern U.S. (< 4.3). This study compares the pH response of pollen from two species of *Aquilegia* that differ in the acidity of the rainfall in their environment. *Aquilegia caerulea* James (Ranunculaceae), a western species, grows at high elevations on rocky ledges. Pollen was obtained from plants in the Snowy Range of southeastern Wyoming. *Aquilegia canadensis* L. (Ranunculaceae), an eastern species, grows on rocky slopes in woody or open sites. Pollen was obtained from plants in Virginia and West Virginia. Fresh pollen from each species was germinated in laboratory media adjusted with sulfuric and nitric acid to result in pH's ranging from pH 3.5 to pH 7.5. Pollen samples were stained and examined using a light microscope. Pollen germination was analyzed by ANOVA (SYSTAT VERSION 6.1). *Aquilegia canadensis* has maximal pollen germination at pH 4.5. Pollen germination significantly decreases at pH 3.5. *Aquilegia caerulea* has maximal pollen germination at pH 5.5, and germination significantly decreases at pH 4.5 and pH 3.5. *A. caerulea* pollen appears well suited to the high rainfall pH in the West. The unusually high germination of *A. canadensis* pollen at pH 4.5 suggests that pollen from this eastern species may be tolerant to the acid rain in its environment.

- 60 FRIECE, MONICA P.¹ AND ERIC F. PAULEY². ¹Dept. Marine Science and ²Dept. Biology, Coastal Carolina University, Conway, SC 29528. Effects of low salinities and soil types on germination and growth of *Sapium sebiferum* (Chinese tallow) seedlings.

Sapium sebiferum (Chinese tallow), a small tree of the Euphorbiaceae, was introduced from China into North America in the 18th century. *Sapium* is now well-established in coastal wetlands of the Southeast and is abundant on dredged soils in some areas. Estuarine wetlands are subject to varying salinities from river flow, tides, and hurricane surges. This study examined the interactive effects of low salinities and soil types on *Sapium* germination and first-year growth. Seeds collected from Winyah Bay, near Georgetown, South Carolina, were planted in three different soils (all supporting *Sapium* in the field) in a greenhouse and regularly watered with 0, 2, 4, 6, 8, and 10ppt salinities. Little germination of planted seeds occurred at salinities above 4ppt. Salinities ≥ 2 ppt significantly reduced seedling growth (e.g., dry weight, stem length, leaf count). Significant salinity X soil type interactions were present. Seedling growth on soils dredged from Winyah Bay (silty clay loam, pH 5.1) was more sensitive to higher salinities than either a gleyed silty clay loam (pH 6.5) or a sandy loam (pH 4.6). Although effects varied among soils, elevated salinity strongly influences *Sapium* germination and growth and could limit its establishment in estuarine wetlands.

- 61 LANGLEY, SUSAN K.¹ AND CECIL C. FROST². ¹Dept. Botany, North Carolina State University, Raleigh, NC 27695-7612 and ²North Carolina Plant Conservation Program, P.O. Box 27647, Raleigh, NC 27611 - Mapping fire compartments using a geographic information system.

Fire frequency is often cited as one of the most important processes underlying the historical and current distributions of longleaf pine, *Pinus palustris*, in the U.S. Fire severity and frequency varied across the landscape according to topographic position, moisture regime, fuel source and abundance, and natural firebreaks. Natural 'fire compartments' may have existed. A 'fire compartment' may be defined as the total area that would typically burn with one ignition until stopped by natural firebreaks. Firebreaks include areas too wet to burn, such as swamps, open water like lakes, ponds, rivers, and wide streams, and areas too arid

or rocky to develop fuel sufficient to carry a fire. Topographic firebreaks include steep slopes and bluffs. Longleaf pine is present in several stands in the Uwharrie National Forest, located in Montgomery, Randolph, and Davidson Counties in North Carolina. A geographic information system (GIS) layer containing watershed information was used in conjunction with a slope-class map derived from a digital elevation model (DEM) to produce a map of the fire compartments in this National Forest. Historical records, soil maps, and remnant natural fire vegetation were used to assess the accuracy of selected fire compartments.

- 62 BERRY, MONICA L.¹, JOE A. ELLINGTON¹, PAT J. ENGLISH², CALVIN L. MCCULLOUGH¹, JOHNEY E. MITCHELL¹, MARTIN L. MITCHELL¹, AND SHERRI L. DEFAUW¹. ¹Dept. Biological Sciences and ²Div. Computer Information Systems, Delta State University, Cleveland, MS 38733 - Landscape transitions on Dahomey N.W.R., Bolivar County, Mississippi.

We evaluated spatiotemporal changes in the landscape components of Dahomey National Wildlife Refuge - now a 10,000+ acre mosaic of bottomland hardwood forest and agricultural tracts situated in Bolivar County, MS. Patch elongation, shape factor (SF), grain shape index (GSI), and fractal dimensions were assessed on this terrain (Nov. 1988, Nov. 1990, and Oct.-Nov. 1998) encompassed by the Alluvial Plain physiographic province. The refuge is best described as a "large-patch" landscape with a broadly meandering, dendritic underprint. The agriculture-dominated matrix is highly subdivided by roads, bayous, and hedgerows. Over a ten-year period, notable shifts in overall pattern include a decrease in wetland acreage (from 2.8% down to 1.8% of total acreage) and an increase in cropland (from 16.5% to 25% of total acreage), the latter due to recent property acquisitions adjacent to forested "outliers". Shape factor (SF) values for forested tracts range from 0.47-0.98; cropland SFs vary from 0.29-0.84 (indicating considerable variability in elongation). Distinctive wetland areas have SF values ranging from 0.66-1.00. Dahomey N.W.R. provides numerous opportunities for the gathering of key empirical data on stream corridor widths (to effectively buffer/remediate inputs from adjacent agricultural tracts) as well as revealing how variations in network complexity, boundary curvilinearity, adjacencies, and mesh sizes may influence biodiversity and ecological processes on a regional scale.

- 63 MILLER III, HUGH A., GREG HEMONTOLER, ERIC BOWMAN, MICHAEL OWSTON, AND LESLIE BROWN. East Tennessee State University, Johnson City, TN 37614. Plant Natriuretic Peptide (PNP): Water Stress Response is Absciscic Acid Dependent.

Plant Natriuretic Peptide (PNP), a homologue to Atrial Natriuretic Peptide (ANP), has recently been identified in many plant species. Since ANP is involved with water and solute transport in animals, we hypothesized that PNP might have a similar role in plants. One approach to ascertain the role of PNP in water movement is to test whether PNP gene expression is affected by water stress. A partial cDNA for PNP was isolated and sequenced. This cDNA was used to generate the RNA probe for measuring PNP gene expression via Ribonuclease Protection Assays and to design primers to support RT-PCR analysis. *Arabidopsis thaliana* plants were subjected to water stress and after 4 days, the expression of PNP decreased as compared to control plants. Absciscic acid (ABA) mediates a plant's response to water stress and many genes have been shown to be influenced by ABA. Determining whether PNP expression is ABA dependent was accomplished by examining PNP expression in ABA-deficient mutants. During water stress, mutants of *Arabidopsis*, *aba-1*, maintained PNP expression, even after 6 days of desiccation. These results support a role for PNP in plant water relations.

- 64 HOLT, TERRI, MARCIA HARRISON, AND JAGAN VALLURI. Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - Characterization of molecular responses in gravistimulated pea stems.

The objective of this project is to investigate the changes in gene expression after gravistimulation (change in orientation to gravity) in dark-grown pea seedlings exposed to red light. Red light is known to enhance graviperception and alter the localization of growth in dark-grown pea stems. Gravistimulation also alters the pattern of cellular growth along the stem resulting in a characteristic upward gravitropic curvature. These changes in cell growth are necessarily linked to enzymatic activities in the cell wall which facilitate loosening of the matrix and increase elasticity in growing cells. Analysis of the soluble cell wall and cytoplasmic proteins during gravitropic curvature was investigated using SDS-PAGE gels. For protein labeling, 5 to 10 seedling shoots were diced into 1 mm pieces and incubated at approximately 23°C for 1.5 h in 50 l of water containing

150 Ci of ^{35}S -methionine (1100 Ci/mmol, ICN). After labeling, tissue was washed with cold 1mM methionine. Tissue was then homogenized in ice-cold 50 mM Tris-HCl buffer (pH 8.65), containing 20 mM KCl and 10 mM MgCl_2 . The slurry was centrifuged at 13,000 g for 15 min and the supernatant was collected for protein analysis. Incorporation of label into protein was determined by scintillation counting after precipitation in 10% TCA. *In vivo* synthesized proteins were separated on one dimensional acrylamide gels. Preliminary analysis of cell wall proteins separated by SDS-PAGE and silver stained revealed 23 extracellular proteins ranging from 10-150 kD in size.

- 65 ESTILL, JAMES, MARK CAMARA, MITCH CRUZAN AND KEN MCFARLAND. University of Tennessee, Knoxville - A survey of World Wide Web Use by students in Introductory Botany and General Ecology at the University of Tennessee, Knoxville.

Over the past three years, we have developed web-based resources for both the Introductory Botany and General Ecology courses at the University of Tennessee, Knoxville. These resources include online discussion groups, textbook chapter outlines, and practice quizzes with answer keys. A list of relevant web links has been compiled for each course, and an online tutorial of library resources in ecology is offered. Surveys were conducted in the Fall Semester of 1998 in order to ascertain the computer literacy of the students, their use of these resources, and the impact they had on student learning. We present the results of our surveys, and offer suggestions of how the World Wide Web can effectively be used as an auxiliary resource in introductory biology courses.

- 66 JAGAN V. VALLURI AND H. W. ELMORE, Dept. Biological Sciences, Marshall University, Huntington, WV 25755. - BandAnalyzer software for determination of protein Rf values and calculation of molecular weight

Determining Rf values of proteins typically involves measuring electrophoretic band migration with a ruler. The practice of measuring and the process of calculating Rf values is tedious and time consuming. Software has been developed that allows rapid and efficient computer-aided measurement of migration and expedites the calculation of molecular weight. Gels are scanned and the image is analyzed with BandAnalyzer. A scanned image of a ruler is used to calibrate band migration distance. Measurements are easily determined with the mouse. Measurements of standards are automatically entered into Excel and a regression line is calculated. A printout of Rf values and molecular weights is generated. The software is user friendly and equally useful in the teaching or research laboratory.

- 67 MATHIS, MARILYN J., BETH A. MIDDLETON, DAVID J. GIBSON, AND ANDREW T. LUMPE. Dept. of Plant Biology, Southern Illinois University, Carbondale, IL 62901 - Long-term succession for undergraduate education and research.

In 1996 we set up a series of long-term, experimental field plots (funded by the National Science Foundation) at a wetland and an upland site for the purpose of improving undergraduate instruction in ecology. Our goal was to improve the curriculum by incorporating inquiry learning as the instruction model. The new labs that we have designed around these field settings are being used to replace the more traditional observation-style labs in lower and upper division biology and education courses. In the two-hour lower division labs, we used the directed-inquiry approach to guide the students in testing a hypothesis that they made in the field. A three-lab sequence for general biology students allows more complex hypotheses to be tested. Our field sites provide the setting for a semester-long ecology methods course to test several ecological concepts such as mechanisms of succession. The wetland site is being used for a dissertation project involving deer herbivory and old field succession.

- 68 CRUZAN, MITCHELL B., AND JAMES C. ESTILL. University of Tennessee, Knoxville - Genetic diversity in endemic species: assessing the roles of historical and contemporary processes.

The distribution of genetic variation among populations of a species is determined by historical relationships and contemporary patterns of gene flow. Examination of genetic diversity using nuclear markers (e.g., allozymes) may provide information on current patterns of genetic exchange, but these techniques lose their utility for comparisons among populations that have been isolated for longer periods of time. Recently developed methods for the analysis of intraspecific phylogeography can be used to infer the historical processes that have produced endemic distributions. These methods primarily rely on the use of sequence variation in nonrecombining and maternally inherited cytoplasmic genomes to estimate relationships among individual genotypes. This phylogenetic information is then combined with the geographic distribution of genotypes to infer range expansion or contraction, past fragmentation, migration, and historical distributions. Information on historical processes that have contributed to endemism will provide insights into ecological factors and the prospects for long term survival.

- 69 WERTH, CHARLES R.¹, WARREN H. WAGNER, JR.², FLORENCE S. WAGNER², AND A. MURRAY EVANS³. ¹Texas Tech University, ²University of Michigan, And ³University of Tennessee - Allopatry, allopolyploidy, dispersal, and endemism: Origin of pteridophyte species in the temperate southeastern United States.

Two modes of speciation prevail in plants in general and pteridophytes in particular: (1) the allopatric mode whereby speciation results from geographic divergence in isolated population systems and (2) allopolyploidization, whereby new species arise in sympatry from interspecific hybrids. Due to the propensity of spores to disperse long distances, the scale of geographic distance that can effect isolation is greater for most pteridophytes than for most seed plants, resulting in constrained rates of allopatric speciation. This is evident in lower levels of regional endemism in pteridophytes than in angiosperms, especially in northern continental floras. In the southeastern U.S. (SEUS), only a handful of pteridophyte species can be characterized as sub-regional endemics diverged from close relatives with ranges near to or including SEUS. However, there are a greater number of predominantly SEUS divergent species whose metropolises, and probably origins as well, are in the SEUS but whose ranges extend into other regions. Furthermore, several wide-ranging eastern North American pteridophyte species exhibit strong geographic patterns of genetic variation, primarily N-S clines that may reflect pre- and post-glacial migrations. The SEUS has been an arena for the origin of a number of allopolyploid pteridophytes, some of which presently are SEUS endemics of recent origin while others appear to be much older with wider, perhaps even global, distributions. Certain of these allopolyploids appear to have originated only once, while others show evidence of multiple origins.

- 70 ANDERS, CONSTANCE M.¹, NICHOLAS DROZDA¹, ALEX PLOCIK¹, AND ZACK E. MURRELL². ¹Departments of Biology, Western Kentucky University, Bowling Green, KY 42101 and ²Appalachian State University, Boone, NC 28608 - Biogeographical implications of variation in *Spiraea virginiana* Britton

Spiraea virginiana is a federally listed rhizomatous shrub endemic to the southern Blue Ridge and Appalachian Plateau Provinces. Typical habitat is found along scoured sections of high gradient streams within the Ohio River drainage. Present evidence indicates the species is reproducing asexually, most probably through the deposition of rhizomes from upstream populations forming new downstream ramets. There is considerable confusion, therefore, regarding identification of individuals and thus difficulty exists in evaluating population size and structure. Phenotypic variation was examined through a morphometric evaluation of 25 leaf measurements and analyzed using a Principal Components Analysis (PCA). Identity and structure at the molecular level was examined with Randomly Amplified Polymorphic DNA (RAPDs) and band patterns were used to construct a cluster analysis. Two biogeographical apriori hypotheses were tested: 1) *S. virginiana* migrated south during Pleistocene glaciation and recolonized northward in the wake of the retreating icesheet (Delcourt and Delcourt, 1986), 2) *S. virginiana* was widespread and persisted during glaciation, allowing northern ancestral populations to invade areas of disturbance left by the retreating icesheet (Ogle, 1991). Analysis of the combined data suggests complex post Pleistocene events produced the current distribution of *Spiraea virginiana*.

71. MCCARTNEY, ELIZABETH A.¹, JERI W. HIGGINBOTHAM², AND R. DAVID WHETSTONE¹. ¹Jacksonville State University, Jacksonville, AL 36265 and ²Transylvania University, Lexington, KY 40508 – Conservation biology of *Sagittaria secundifolia* (Alismataceae).

Sagittaria secundifolia, Kral's Water-Plantain, is a perennial, aquatic herb currently known to exist only in Little River which is located in northeastern Alabama and northwestern Georgia. On May 14, 1990, *S. secundifolia* was designated a threatened species by the United States Fish and Wildlife Service. A pedestrian survey of Little River within Little River Canyon National Preserve was conducted in order to revisit known populations, and document new populations. Study sites were established. The West and East forks provide the most ideal habitat for *S. secundifolia* with an abundance of shallow riffles, flat sandstone, and sandstone rubble. *S. secundifolia* is rarely found in areas with deep pools and huge boulders. Populations of *S. secundifolia* were found in various water depths and diverse amounts of canopy cover. Although reproduction is thought to be mainly clonal, flowering does occur, and heterozygosity has been observed for certain isozymes. Genetic diversity was determined using starch gel electrophoresis. Because *S. secundifolia* is a narrow endemic species, low genetic diversity was anticipated. However, the amount of variability in *S. secundifolia* was higher than expected when compared with other *Sagittaria* species. Polymorphism has been detected in all six study populations.

72. WELCH, NICOLE TURRILL¹ AND THOMAS A. WALDROP². ¹School of Public and Environmental Affairs, Indiana University, Bloomington, IN 47405 and ²USDA Forest Service, Southern Research Station, Clemson, SC 29634 – Restoring *Pinus pungens* communities with prescribed fire: theory and practical applications.

Pinus pungens communities of the southern Appalachian Mountains have been maintained historically by lightning- and human-caused fires. Characteristic stands have a *P. pungens* overstory, a *Quercus prinus*, *Q. coccinea* and *Nyssa sylvatica* understory, and a *Kalmia latifolia* shrub layer. Following more than sixty years of fire suppression, most stands have increased densities of *Quercus* spp. and *K. latifolia* as well as fire-intolerant species such as *Acer rubrum* and *P. strobus*. Previous research suggests that restoration of these communities can only be accomplished with high intensity fires that open the forest canopy and expose mineral soil. Two recent studies examined community response to prescribed burning. Low to medium intensity fires reduced canopy cover by 30-40% but promoted sprouting of midstory and understory hardwoods. Pine regeneration following such burns was insufficient to restore the stand. Medium to high intensity fires killed 96% of overstory trees and allowed abundant pine regeneration on deep duff layers. Studies comparing *P. pungens* seedling survival on mineral soil and duff are needed. Future efforts to restore these communities should conduct multiple burns to reduce hardwood competition and open the forest canopy. Opportunities to conduct such burns, however, are limited under current prescribed burning guidelines.

73. BRUCE A. SORRIE AND ALAN S. WEAKLEY. Independent consultant and Southeastern Regional Office of The Nature Conservancy - Coastal plain endemics: phytogeographic patterns.

The Atlantic and Gulf Coastal Plains of North America stretch from southeastern New England to northeastern Mexico (including the Mississippi Embayment) and support a very large and diverse assemblage of plants. We recognize 45 genera and 1360 species endemic to this region, plus another 140 infraspecific taxa. Individually, these plants do not occur throughout the coastal plain, but are distributed in well-defined geographical areas. We identify eighteen major distribution patterns, scattered along the whole length of the coastal plain. Each pattern, or geographical area, represents the shared distribution of a suite of species, all of which are restricted to or endemic to that pattern. Nine of the areas support one or more endemic genus. Due to the high incidence of localized taxa, each pattern can be viewed as a center of endemism. Analysis of these centers suggests possible pathways of speciation within the coastal plain.

74. LEBLOND, RICHARD J. North Carolina Natural Heritage Program - Investigation of geological and ecological conditions associated with plant endemism in the Cape Fear Arch region of North and South Carolina.

At least 23 plant taxa are strictly endemic to the coastal plain of North and South Carolina, primarily in the Cape Fear Arch region, while another 32 taxa have at least 75% of their geographic distribution

restricted to the same area. Potential contributing environmental factors are investigated, including underlying geology, sea level fluctuation and shoreline migration, climate, soils, hydrology, plant dispersal, and availability of suitable habitat. The data suggest that regional speciation and relictual isolation account for the presence of a majority of these endemics and near-endemics.

- 75 MENGES, ERIC S.¹, REBECCA W. DOLAN², REBECCA YAHR³, AND DORIA R. GORDON⁴ - Comparative genetics of seven plants endemic to Florida's Lake Wales Ridge.
¹Archbold Biological Station, ²Dept. of Biological Sciences, Butler University, ³Dept. of Botany, Duke University, and ⁴The Nature Conservancy and the University of Florida

We describe the genetic variation and structure of seven narrowly-endemic, federally-endangered Florida scrub species with varying life histories, degrees of habitat specialization, and distributions. Measures of genetic (isozyme) diversity vary among species, but 5 of 7 species had expected heterozygosity values lower than the published mean for narrow endemics. Most measures of species and population level genetic variation produced the same ranking among species (using expected heterozygosity): *Liatris ohlingerae* > *Dicerandra christmanii* > *Nolina brittoniana* > *Eryngium cuneifolium* > *D. frutescens* > *Warea carteri* > *H. cumulicola*. We compared genetic rankings with rankings of eight life history traits. Genetic variation was highest in longer-lived, demographically-stable, outcrossing, longer-distance pollinated species. Attributes such as median population size, habitat specificity, and geographic range were inconsistent with genetic rankings. Seed dispersal distances varied little among our species. All but one species had limited genetic variation among populations. The exception (*H. cumulicola*; $F_{ST} = 0.73$), is pollinated by specialized bees that move short distances, and may have limited gene flow among isolated patches. These comparisons emphasize that co-occurring narrowly endemic species can have a diversity of genetic patterns and that many factors can potentially influence the amount and distribution of genetic variation.

- 76 LACEY, ELIZABETH P.¹, ALEJANDRO ROYO¹, RAMONA BATES¹, AND DAVID HERR².
¹Dept. of Biology, University of North Carolina, Greensboro, NC 27402 and ²Dept. of Mathematics, University of North Carolina, Greensboro, NC 27402 - The role of matrix models in biogeographic studies of plant species: evidence from a study of *Lobelia boykinii*, a rare plant species endemic to the Carolina Bays.

Floristic surveys indicate that many rare plant species are found in populations scattered throughout coastal wetlands of the southeastern United States. These surveys are useful in determining the biogeographic range of a species. However, because these surveys typically provide only presence/absence data or an estimate for population size at only one time, they are often not useful for assessing the health of a species' populations. Here we argue that matrix modeling is more useful in estimating the health of extant populations and in predicting future biogeographic trends. To support this view, we summarize the results of a demographic study of *Lobelia boykinii*, a plant species endemic to the Carolina Bays. This study used matrix modeling to predict the status of each population and to determine the stage in the life cycle that most influences population growth. Matrix models indicate that population persistence in *L. boykinii* is strongly influenced by bay hydrology and frequency of fire. In the absence of human intervention to protect the species, the number of populations, and hence biogeographic distribution, is expected to decline dramatically in the next 50 years.

- 77 ALLISON, JAMES R. AND TIMOTHY E. STEVENS. Georgia Dept. of Natural Resources and Alabama Dept. of Public Health Laboratories - The Endemic Flora of the Ketona Dolomite Glades of Alabama.

Explorations of Ketona Dolomite outcrops and their environs in Bibb County, Alabama, have resulted in the discovery of a distinctive, previously undescribed endemic plant community. Characteristic elements of this community include multiple taxa new to science, several species disjunct from all previously known stations by hundreds of kilometers, a *Solanum* lost to science for some 160 years, and dozens of other species that are rare or otherwise unknown in Alabama. Newly described are *Castilleja kraliana*, *Corcopsis grandiflora* var. *inclinata*, *Dalea cahaba*, *Erigeron strigosus* var. *dolomiticola*, *Liatris oligocephala*, *Onosmodium decipiens*, and *Silphium glutinosum*; an eighth endemic taxon has already been described (*Spigelia gentianoides* var. *alabamensis* K. Gould). It is astonishing that a habitat which in aggregate comprises today at most 15 hectares should support

such a rich endemic flora. Likely explanations include a combination of edaphic specialization for shallow, droughty, high-magnesium soil; geographic isolation; relictualism; a rural setting with intact natural habitats, and chance dispersal events.

- 78 BASKAUF, CAROL J. Austin Peay State University, Clarksville, TN 37044 -Examining rarity through comparisons with widespread congeners: a genetic and ecophysiological example from limestone glade endemics.

Studies comparing rare and widespread congeners are particularly valuable when examining hypotheses regarding the condition of rarity. A comparison of close relatives can minimize the confounding effects of phylogenetic history and, optimally, eliminate ecological factors which are not directly relevant. Among the various hypotheses regarding rarity, this paper focuses on genetic correlates and potential ecophysiological restrictions. A comparison from the coneflower genus *Echinacea* is used as the primary example: *Echinacea tennesseensis* is an endangered species endemic to the limestone glades ("cedar glades") of middle Tennessee. *Echinacea angustifolia*, a widespread prairie species, is considered a close relative. A genetic comparison of the rare *E. tennesseensis* with its widespread prairie relative supports the hypothesis that rare species have lower levels of genetic variability within populations than do widespread species (although the partitioning of genetic variability among populations does not differ). However, an ecophysiological study measuring photosynthesis levels following different light and soil moisture preconditioning regimes provides no evidence that narrow physiological tolerances for these factors are responsible for the endemic species' narrow geographic range. These results are compared with other genetic studies involving cedar glade endemics and other ecophysiological studies comparing rare and widespread congeners.

- 79 LEVY, FOSTER AND KIMBERLY A. MALONE. Dept. Biological Sciences, East Tennessee State University, Johnson City, TN. 37601 - *Phacelia dubia* in South Carolina, a key step in the pathway to endemism.

The three recognized varieties of *Phacelia dubia* are allopatric, morphologically distinct and all hybrid combinations show partial hybrid sterility. The species is known to occur on granite outcrops in South Carolina where many populations are morphologically similar to the widespread var. *dubia* rather than the granite endemic, var. *georgiana*. South Carolina plants show partial sterility in hybridizations with either var. *dubia* or var. *georgiana*. The source of the reproductive barrier was traced to region of the genome marked by the allozyme locus GOT2. Molecular mapping indicates genomic rearrangements such as reciprocal translocations are the most likely cause of hybrid sterility among all forms of *P. dubia*. The GOT2 region is also implicated in sterility among other varietal pairs with the magnitude of the sterility and the identity of the sterility-causing genomic regions suggesting possible geographic pathways for the evolution of sub-specific differentiation in *P. dubia*. Derivations from a Mexican ancestor may have proceeded from the Tennessee cedar glade endemic, var. *interior*, to South Carolina followed by northern diversification of var. *dubia* and southern differentiation of var. *georgiana*. Alternatively, either var. *dubia* or var. *georgiana* may represent ancestral forms with populations in South Carolina serving as a source for further diversification to the west and north or south respectively.

- 80 MURDY, WILLIAM H. AND M. ELOISE BROWN CARTER. Oxford College of Emory University - *Speciation in Talinum in the Southeast.*

Five terete-leaved *Talinum* species occur in the Southeast on granite, sandstone, shale or limestone outcroppings. All are summer-flowering perennials with succulent leaves and ephemeral, rose-colored flowers. *Talinum parviflorum* (2n=24) has tiny flowers that open late in the day and self-pollinate. The species is distributed in the central U.S. from Arkansas westward, but an outlier population, formerly named *T. appalachianum*, occurs in north Alabama. *Talinum mengesii* populations are predominantly diploid (2n=24). The species, distributed in northern Alabama and southeastern Tennessee, occurs on both granite and sandstone. Two isolated enclaves are not contiguous with the rest of the species and intervening outcrops have only *T. teretifolium*. *Talinum teretifolium* (2n=48), distributed from Georgia to Pennsylvania, is an allopolyploid derived from *T. mengesii* and *T. parviflorum*. This conclusion is based on morphological, reproductive and biochemical evidence, and the recreation of the species from parental species. *Talinum calcaricum* (2n=48) is endemic to limestone outcrops in Tennessee and Alabama. Evidence presented suggests a derivation from *T. calycinum*,

distributed from Arkansas westward and having both diploid and tetraploid populations that grow on shale, sandstone or limestone. While these species are 100% interfertile, reasons are given to maintain the two as separate species.

- 81 MELLINGER, CLAIR. Biology Department, Eastern Mennonite University, Harrisonburg VA 22802 - Ecological life cycle of *Viguiera porteri* (Asteraceae) and factors responsible for its endemism to granite outcrops of Georgia and Alabama.

The life cycle of the fall annual, *Viguiera porteri*, was studied to ascertain its success on and restriction to shallow-soiled communities of Piedmont granite outcrops of Georgia and Alabama. Studies were conducted on populations growing on natural outcrops, simulated outcrops, and non-outcrop habitats. Genetic differences among geographically isolated populations of *V. porteri* were also examined. Survival in the wilted condition during drought stress allows *V. porteri* to survive the frequent droughts of this environment. Although it is an annual, significant numbers of ungerminated seeds survive for at least two years in outcrop soils. These two factors appear to be critical life cycle features that allow *V. porteri* to survive the harsh outcrop environment. Low seed germination and the inability to absorb water at low soil water potentials prevent it from competing with old field weeds and other plants in non-outcrop soils. Significant morphological differences among populations are not apparent when the plants are grown under uniform environmental conditions but a great deal of plasticity can be found within each outcrop population.

- 82 VOGEL, STEVEN. Dept. Zoology, Duke University, Durham, NC 27708 - The Last Word About All of Biology.

Whether taken by major or non-major, "introductory" biology is the last course that addresses biology as a whole. That should define its mission—to explain life, the most peculiar phenomenon in the universe—for anyone who regards biology as a distinct subject rather than some accidental federation. We must set it in the context of the physical sciences, describe how it might have begun, show how it persists and can become more complicated over time, make sense of its complex and hierarchical internal organization, and examine the features that all living systems have in common. We have to explore how life reacts to perturbations—from point mutations and short-term stresses to asteroid collisions and the present plague of humans. And we must not get lost in terminology and detail, however handy these might be for examinations and whatever the urgings of teachers of advanced courses. Above all, we cannot lose sight of the special role of the course that takes the name "biology" literally as it asks what we can say about life.

- 83 SPRATT, HENRY G., Jr., KRISTEN B. HOWERTON, and NICHOLAS E. DOBOSH. The University of Tennessee at Chattanooga - The effects of clear-cutting and selective harvest of timber on carbon, sulfur, and nitrogen transformations in surface soils of a Missouri Ozark forest

Transformations of C, S, and N were determined for A- and B-horizon soils collected from 12 permanent plots located in the Missouri Ozark Forest Ecosystem Project (MOFEP) in southeastern Missouri from May 1995 to May 1998. Harvesting of timber by clear-cutting (C-C) or selective cutting occurred beginning in May 1996, and was completed by October 1996. Mineralization of ^{14}C -lignocellulose (of *Quercus alba*) was used as a measure of microbial activity in the soils. *Quercus alba* is the predominant overstory tree species on MOFEP plots. Total C, N, and S (TC, TN, and TS) were determined by elemental analysis. S transformations determined included microbial production and mineralization of organic S (OS), using established ^{35}S methodology. S pools quantified included: TS, water soluble SO_4 , adsorbed SO_4 , and OS (determined by difference). A-horizon soils from C-C sites initially had higher rates of cellulose mineralization than controls, but declined 2 y post harvest. Rates of lignin mineralization generally declined post harvest. Concentrations of TC in A-horizon soils were lower in C-C soils than controls on all dates beginning 1 y post harvest (declining by as much as 35% compared with pretreatment soils). Total S of both A- horizon soils decreased by nearly 40% after C-C, while B-horizon soils tended to show an increase in TS following C-C (up nearly 73%). Interestingly, the TS content of litter falling into C-C sites increased by nearly 50% 2 y post harvest. Total N was lowest in C-C plots. The relative effect of the loss of TS from A-horizon soils, with a buildup of TS (possibly as SO_4 from mineralized A-horizon OS) in B-horizon soils on the exchangeable bases K and Mg is currently being assessed. A potential role for loss of K and Mg in the reduced rates of microbial lignocellulose mineralization in these surface soils is also under investigation. This work has been supported by grants from the Missouri Dept. of Conservation, and the USDA, NRICGP.

- 84 RESSLER, DEBRA A., HENRY G. SPRATT, Jr., and ANN E. STAPLETON. The University of Tennessee at Chattanooga – Effects of UV Radiation on the Degradation Capabilities of Two Strains of Oil Degrading Bacteria

The relative effect of UV radiation exposure on two oil degrading cultures was determined in mesocosm experiments. Twelve mesocosms were constructed out of 10 gallon aquaria into which 12.5 kg of autoclaved soil was added. Used crankcase oil was added to eight mesocosms (200ml/kg of soil). Anthracene, dissolved in DMSO, was added to the remaining four mesocosms (25mg/kg soil) as a source of control for PAH degradation. The mesocosms were then placed in a temperature-controlled chamber, maintained at 32°C. Soils were inoculated with either a commercially marketed bacterial product or an oil degrading *Acinetobacter* species isolated from local oil contaminated surface soils. One-half of the mesocosms were exposed to UV-B radiation. Each test condition had a series of sodium azide killed-control setups, to account for the PAHs that sorbed to the soil matrix. Quantification of the degradation of oil by these isolates using hexane extraction and EPA Method 8270 is currently underway. The mesocosms and killed-controlled containers will be used to determine the effects of UV radiation on the degradation of used motor oil and anthracene. Additionally, a comparison between the degradation rates of both bacterial species will be determined. It is hoped that the results of this work may impact typical *in situ* bioremediation strategies.

- 85 HOWERTON, KRISTEN B. AND HENRY G. SPRATT, Jr. The University of Tennessee at Chattanooga – Determination of lignocellulose and herbicide degradation rates by forest soil microorganisms in relation to herbicide exposure.

The relative effect of herbicide exposure on lignocellulose and herbicide degradation by forest soil microorganisms was assessed in surface soils collected from the Tennessee River Gorge. Approximately 20-kg soil samples were collected from TRG. The unautoclaved soil was placed equally in six 10gal-aquarium tanks to a depth of 15cm. Tanks were treated in duplicate with commonly used acetanilide-derived herbicides. Mesocosms were kept at room temperature and uncovered. Soil core samples were taken at 2 week intervals over a 2 month period. Core samples were used to set up a microcosm apparatus. Radiolabeled lignin, cellulose, and herbicide (.005g) and soil (1g) were added to a 20ml glass jar fitted with a CO₂ collection trap using 2ml NaOH. The NaOH was collected every other day during each two week incubation (room temp) and analyzed via scintillation counting to quantify ¹⁴CO₂ relative to rates of lignocellulose or herbicide depletion. To determine the relative effectiveness of our study pure cultures of a white rot fungi, *Phanerochaete chrysosporium* were treated using the same ¹⁴C-labeled substrates as used in the mesocosms. Also, microbial cultures from each mesocosm tank were isolated. The effectiveness of these cultures to degrade ¹⁴C-lignocellulose and ¹⁴C-herbicide was compared with that of the *P. chrysosporium*. Results of this investigation have implications in limiting the overuse of herbicides in silviculture.

- 86 BURDETTE, JILL E., AND HENRY G. SPRATT, JR. University of Tennessee at Chattanooga, TN 37403- Determination of microbial biomass in surface soils of the Tennessee River Gorge.

Microbial biomass in surface soils of the Tennessee River Gorge (TNG) was assessed using the chloroform fumigation-incubation (CFIM) technique. Surface soils from the TNG, a relatively undisturbed site located within the metropolitan Chattanooga area, were collected from four permanent plots in the TNG. CFIM floods soil with chloroform, killing the microorganisms and releasing the cytoplasmic contents of the microorganisms as utilizable carbon to the soil organic matter pool. This carbon is quantified using a potassium dichromate digestion followed by a ferrous ammonium sulfate titration and then related to the amount of biomass in the soil. Trial runs have been performed to test and perfect this method using soil taken from extensively studied plots in Southeast Missouri. The method is being tested and validated by several means, including determination of a more effective titration indicator and improving the effectiveness of the chloroform fumigation. Preliminary data of the carbon extracted from the Missouri soil against a blank digestion suggests that the amount of carbon is $416 \pm 0.16 \mu\text{g C g}^{-1}$, which fits the data from other similar studies. After a baseline of microbial biomass for soils from TNG is established, future studies may include comparison of changes in microbial activity as a result of leaf litter input, CO₂ levels in the atmosphere, or acidic precipitation. Future comparisons may also be made to document the efficacy of a nearby cement company's upcoming restoration of a former rock quarry located within TNG to a more natural habitat.

- 37 AL-DUJAILI, JAMEEL AND MICHAEL FONTENOT, Louisiana State University at Eunice. Assessment of drinking water quality in the southwest Louisiana community area.

The microbiological quality of tap water from 31 residences was studied. In addition, different factors that might influence the bacteriological contamination of tap water were examined. Aerobic and facultative anaerobic heterotrophic bacteria, total coliform and one indicator for fecal contamination (fecal Streptococci) were enumerated. It was found that 64% of the tap water samples from the residences was contaminated by at least one coliform or indicator bacterium. This study also found that the residual chlorine levels were 0.25-0.50 mg/liter and 0.510.90 mg/liter in 32% and 39% of tap water samples respectively. Meanwhile, the residual chlorine levels 0.91-1.5 mg/liter or higher were found in 29% of tap water samples. Moreover, we obtained an HPC of at least 10^3 CFU/ml for 25% of the tap water samples. Generally, this indicator is used to establish the effectiveness of the treatment methods and the concentration level of treatment agents used in Southwest Louisiana community area.

- 88 BENJAMIN, EBONY, GEROD HALL, ANN C. WILLIAMS, AND L. FREDERICK. Howard University, Washington, DC - Electrophoresis studies on culture filtrates of *Bacillus* sp. with antifungal properties.

Preliminary studies have been conducted on sterilized culture filtrates from liquid shake cultures of an undetermined species of *Bacillus* that produces substances with antifungal properties. The filtrates have been analyzed by polyacrylamide gel electrophoresis. Filtrates were obtained by growing the bacterium in shake culture in a potato-dextrose broth and in Takai's nutrient medium. Cultures were centrifuged to remove bacterial cells and the supernatant sterilized by filtration. Aliquots of the filtrate were applied to gel plates and a standard electrophoresis procedure was followed. Gels were subsequently stained with Coomassie blue. The objective of the study was to separate fractions of the filtrate that might be responsible for the antifungal activity of the bacterium. Results thus far have revealed the presence of two distinct proteins bands and some additional indistinct bands unique to the culture filtrate. More sensitive stains are expected to more clearly delineate protein bands in the filtrate and enable the characterization of the compounds.

- 89 M.R. LIVINGSTON and L.L. LUNDIE, JR. Appalachian State University, Boone N.C. - Isolation and partial characterization of a sulfidogen capable of growth on *n*-hexadecane as the sole carbon source.

A sulfidogenic bacterium capable growth on *n*-hexadecane was isolated from enrichment cultures of soil surrounding an oilfield production water containment pit near Roswell, NM. Isolation of the organism was accomplished by serial transfers of the culture through liquid media containing *n*-hexadecane as the sole carbon/energy source. The cells are nonsporulating Gram negative vibrios. Evidence of metabolic activity was reflected by sulfide production as an indirect measure of *n*-hexadecane utilization. In addition to *n*-hexadecane, the culture grew on sodium salts of lactic, acetic, caproic, caprylic, butyric, stearic, and palmitic acids, and on butanol. Heat-killed controls and cultures amended with 20 mM sodium molybdate produced no sulfide in the presence of the various substrates. The rate of sulfide production over 29 days was as follows: acetate > lactate > butyrate > butanol > stearate ≈ caproate > palmitate > caprylate > *n*-hexadecane. Electron microscopy revealed cells from the lactic acid culture and *n*-hexadecane culture are identical curved rods approximately 1.4 micrometers in length and the RFLP patterns of the 16S rRNA gene from each are identical. These results suggest we have obtained a pure culture. The 16S rRNA sequence, and stoichiometry involving *n*-hexadecane utilization will be compared to known *n*-hexadecane degrading sulfidogens.

- 90 FREDERICK, L., EBONY BENJAMIN, GEROD HALL, AND W. LENA AUSTIN. Howard University, Washington, DC - Studies on a *Bacillus* species that produces substances antagonistic to fungi.

An undetermined species of *Bacillus*, found as a contaminant in a culture plate of a mutant of *Neurospora dodgei*, has been found to produce antifungal compounds. Culture of the bacterium on agar media (potato-dextrose and corn meal) results in the production of diffusible substances that inhibit growth of several species of fungi. Species thus far tested and found to be inhibited by the antifungal compounds are: *Alternaria* sp., *Aspergillus* sp., *Blastomyces* sp., *Candida* sp., *Chaetomium* sp., *Neurospora dodgei*, *N. dodgei* mutant, *Ophiostoma ulmi*, *Penicillium* sp., and *Rhizopus stolonifer*. In addition to challenges of the bacterium on solid media by different fungal species, sterile culture filtrates of potato-dextrose broth cultures of the bacterium, added to nutrient agar media, have been tested for fungal inhibitory activity. Mycelial growth of the test fungi, viz. *Neurospora dodgei* and *Ophiostoma ulmi*, have been strongly inhibited by 50/50 nutrient medium/culture filtrate agar mixtures. The unidentified compounds appear to be more fungistatic than fungicidal.

- 91 FREDERICK, L. AND DILLION T. CHEN. Howard University, Washington, DC - Effect of antifungal substances produced by *Bacillus* sp. on growth and pathogenicity of *Ophiostoma ulmi*.

The effect of antifungal substances, produced by an undetermined species of *Bacillus* on the fungus, *Ophiostoma ulmi* causal agent of the Dutch Elm disease, has been investigated. To conduct these studies sterile culture filtrates of the bacterium from shake cultures in potato-dextrose broth and Takai's *O. ulmi* medium have been obtained and have been incorporated as an additive to agar plates containing these media as well as to culture flasks. Growth responses of the fungus have been measured as mycelial dry weight from liquid cultures and radial growth on agar plates. On agar plates that contain a 50/50 mixture of culture filtrate and nutrient medium (PDA or Takai's agar) mycelial growth of *O. ulmi* is strongly inhibited. In liquid media, mycelial weights are significantly lower in flasks containing a 50/50 mixture of filtrate and medium. Further studies are being conducted to ascertain the extent to which the antifungal substances of the bacterium will affect pathotoxin production by *O. ulmi*.

- 92 BLAIR, BENJIE G. and KEVIN L. ANDERSON. Jacksonville State University and Mississippi State University - Regulation of Cellulose Affinity Proteins of *Eubacterium cellulosolvens* 5494 and *Clostridium cellulovorans* 743B.

E. cellulosolvens and *C. cellulovorans* are gram-positive, cellulolytic bacteria. We have previously observed that small amounts of soluble carbohydrates or glucose analogs result in rapid release of extracellular protuberances from these bacteria. Both organisms were cultivated in a medium containing either glucose, cellobiose, or ball-milled cellulose. In addition, glucose was added to the medium of cellulose-grown cultures and allowed to incubate for 5 min prior to cellulose affinity chromatography. Non-adhering proteins were eluted with 25 mM Tris-HCl (pH 7.0) buffer. Removal of adhering proteins with Tris buffer containing, urea and/or high salts yielded poor results. After adding 10mM EDTA, recovery of cellulose affinity protein increased dramatically. Cellobiose- and cellulose-grown cultures of *E. cellulosolvens* and *C. cellulovorans* were found to possess a cellulase-containing protein fraction. This protein fraction was not detected in glucose grown cultures, and was lost rapidly from cellulose-grown cultures following the addition of glucose to the medium. These results indicate that the subunits for the extracellular protuberances are produced when cellobiose serves as the major substrate. However, the subunits did not form detectable aggregates until after contact with cellulose.

- 93 BRADBURY, ALYCE AND JAMES JOY Dept. Biological Sciences, Marshall University, Huntington, WV 25701 - A comparison of parasitic species from basses in both river and lake ecosystems.

Two-hundred and fifteen basses were collected from four river sites (Racine Locks and Dam; Robert C. Byrd Locks and Dam, Ashland, KY--Ohio River; London Locks and Dam--Kanawha River) and

five reservoir sites (Beech Fork Lake, East Lynn Lake, Summersville Lake, Burnsville Lake, and Stonewall Jackson Lake). The five species of basses caught were largemouth bass, *Micropterus salmoides*, smallmouth bass, *Micropterus dolomieu*, spotted bass, *Micropterus punctulatus*, white bass, *Morone chrysops*, and hybrid bass, *Morone chrysops* x *Morone saxatilis*. Basses were collected by three methods: 1) local anglers (hook and line), 2) gillnetting surveys, and 3) rotenone surveys. Collections were made from May 26, 1997 through November 5, 1997. Within these 215 basses, 21 different parasitic species were collected from the gills and viscera. Dominant species were "small form" monogenetic trematodes (i.e. *Clavunculus* sp., *Haploclidius* sp., and *Uroclidius* sp.) from both river and lake hosts, *Bucephalus polymorphus*, a digenetic trematode from river systems, *Proteocephalus ambloplitis* (pleurocercoids), the bass tapeworm from lake systems, and *Neoechinorhynchus* sp., an acanthocephalan also from lake systems. Comparisons were made between infections of hosts in river versus lake systems to determine if there were any correlation between parasite species and types of aquatic ecosystems. U.S. Army Corps of Engineers Grant

- 94 Bickford, Nate and R.N. Henson, Appalachian State University - Survey of gastrointestinal helminths of small mammals in Watauga County, N.C., and variations in frequency and distribution due to host location, host species, and time of year.

This study surveyed the intestinal helminths (Cestodes, Trematodes, and Nematodes) in small mammals in Watauga County, North Carolina. Mammals were trapped for a year in different microhabitats, such as fields with a stream, fields without a stream, and wooded areas. Changes in the frequency and distribution of helminth populations due to location of host, time of year, and host species were observed. Two hundred small mammals, including *Peromyscus maniculatus*, *Peromyscus leucopus*, *Blarina brevicauda*, *Sigmodon hispidus*, *Synaptomys cooperi*, *Microtus pennsylvanicus*, and *Neotoma cinerea* were examined. *Mesocestoides corti* (Cestoda), *Panopisthus pricei* and *Brachylaima thompsoni* (Trematoda) and six species of nematodes were found. Comparisons were made between frequency and distribution of gastrointestinal parasites, within the intestinal tract. By examining different mammalian hosts, differences in gastrointestinal parasites and parasite loads between and within different species were observed.

- 95 ROGERS, SUSAN O. AND RICHARD J. NEVES. Virginia Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061 - Use of freshwater mussel propagation to aid recovery of endangered species populations.

Freshwater mussel propagation is important to endangered species recovery. Cultured juveniles may be released to augment existing populations or reintroduce a species to a stream where it was found historically. The tan riffleshell (*Epioblasma florentina walkeri*) is being propagated at Virginia Tech for release into the Hiwassee River of Tennessee to augment the residual population and to augment the population in Indian Creek and the Clinch River that was affected by a toxic spill in summer, 1998. Culture techniques are tested on common species as surrogates in order to boost survival and growth of the endangered species. The wavy-rayed lampmussel, *Lampsilis fasciola*, is being used to examine effects of sediment size and light regime on cultured juvenile mussels. Preliminary experiments suggest that the juveniles do poorly in silt (<120µm) as opposed to fine sand (500-800µm), coarse sand (1000-1400µm), or mixed sediment (<1400µm). Additionally, the juveniles appear to survive and grow better in raceways open to full sunlight rather than no sunlight.

- 96 ESKEW, KELLY R.¹, ROBERT R. MANGINO², AND FRANK S. COROTTO¹ ¹Dept Biology, North Georgia College and State University, Dahlonega, GA 30597 and ²Dacula High School, Dacula, GA 30211 - Role of vision in sex identification of *Procambarus clarkii*.

Sex identification is required for the crayfish *Procambarus clarkii* to mate. We explored the significance of vision in sex identification by observing mating in pairs of control animals, pairs with blinded females, blinded males, and both blinded. Blinding was accomplished by painting eyes with white correction fluid 30 min prior to experimentation. Pairs were placed into a glass bowl (diameter = 19cm), observed for one hour and removed if not mating. If they were mating, they were allowed to finish and then removed. In control and female-blinded pairs five of nine and four of eight pairs mated, respectively. In male-blinded and both-blinded pairs only two of seven and one of eight pairs mated.

respectively. Thus blinding males appeared to reduce the likelihood of mating. This trend was not significant ($X^2=4.16$, $df=3$, $p=0.245$). There was also no significant difference between the groups in delay to mate ($F_{3,10}=1.148$, $p=0.377$) and duration of mate ($F_{3,10}=1.715$, $p=0.227$). However, the longest average delays were found in male-blinded and both-blinded groups (41.0 and 49.0 min vs. 28.3 and 21.7 min in control and female-blinded groups). Collectively these findings suggest that males may rely slightly on vision for sex identification.

- 97 NICHOLS, PHILLIP B.¹, FRANK A. ROMANO, III¹, AND DIANE R. NELSON². ¹Dept. of Biology, Jacksonville State University, Jacksonville, AL and ²Dept. of Biological Sciences, East Tennessee State University, Johnson City, TN - A Distributional Survey of Terrestrial Tardigrades of Dugger Mountain, Alabama

A survey on the distribution of terrestrial tardigrades of Dugger Mountain, Alabama, was performed from April 1997 through June 1998. Cryptogams on 5 trees, 3 on north-facing slopes and 2 on south-facing slopes, were sampled seasonally at three sites (head-waters, mid-waters, mouth-waters) along an unnamed tributary to the South Fork of Terrapin Creek. Trees were chosen based on their location outside the riparian zone at the peak, mid-point, or base of the slope. Tardigrades were extracted and identified, and population dynamics of north and south facing slopes and seasonal and altitudinal variations were determined. Tardigrades identified represented 2 classes, 8 genera, and 14 species; *Macrobiotus areolatus tonollu*; *M. echinogenitus*; *M. islandicus*; *M. richtersi*; *M. sp.* (simplex stage); *Minibiotus intermedius*; *Hypsibius sp.*; *Isohypsbius sp.*; *Mihnesium tardigradum*; *Diphyscou pingue*; *Echiniscus ramazzottii*; *E. virginicus*; *Echiniscus n. sp.*; *Pseudoechiniscus sutllus*. This survey found significant differences between north and south facing slopes. Also, significant differences in site specific seasonal and altitudinal distributions were found.

- 98 ROMANO, FRANK A. Dept. of Biology, Jacksonville State University, Jacksonville, AL - Tardigrades from the campus of Jacksonville State University

Samples of mosses, lichens, leaf litter, and stream bottom were taken across our campus. A total of 15 samples were taken during Spring 1997. Further sampling will occur during Spring 1999. Tardigrades were extracted from these samples and identified. A total of 60 tardigrades were found, representing 2 classes, 3 genera, and 6 species. *Echiniscus veridissimus* (3) was the only member of the class Eutardigrada found. This animal was from moss found on the slate roof of Hammond Hall. The class Heterotardigrada was represented by 3 genera, and the following species (number of specimen collected is within the parentheses), *Macrobiotus areolatus tonollu* (6), *M. huflandi* (4), *M. lucasworthii* (1), *M. sp.* (simplex stage - 12), *Mihnesium tardigradum* (28), and *Minibiotus intermedius* (6). Heterotardigrades were found existing in moss and lichens growing on a wide variety of trees and man-made structures, including 4 tree species, and brick and concrete retaining walls. *Macrobiotus* and *Mihnesium* dominated this collection, accounting for 53% and 46% respectively. Specimen within the *Macrobiotus areolatus tonollu* group are separated using egg morphology. Since no eggs were collected during this survey, they could not be separated. *M. sp.* are organisms that are undergoing the process of molting, and have shed their buccopharyngeal apparatus, thus, could not be identified to species.

- 99 BARRERAS, BLANCA E.¹, FRANK A. ROMANO, III¹, AND DIANE R. NELSON². ¹Dept. of Biology, Jacksonville State University, Jacksonville, AL and ²Dept. of Biological Sciences, East Tennessee State University, Johnson City, TN - A Distributional Survey of Riparian Zone Tardigrada of Choccolocco Creek, Alabama

A distributional survey of riparian zone tardigrade populations of the Choccolocco Creek, Alabama, was undertaken from August 1994 through December 1995. Choccolocco Creek is a 113.6 km (71 miles) long creek that begins in the southern terminus of the Appalachian Mountain Chain (Dugger Mountain area), and flows southwesterly to join the Coosa River near Pell City, Alabama. Six stations were sampled that represented different physiographic portions of this creek, i.e., head waters (stations 1 and 2), mid waters (stations 3 and 4), and mouth waters (stations 5 and 6). At each sampling site 3 trees with moss growth were selected within the riparian zone (within 10 meters of the stream), and 6 seasonal collections were made (108

samples total). A total of 1,588 tardigrades were extracted, mounted, and identified comprising 2 classes, 7 genera, and 12 species (*Echiniscus manecii*, *Echiniscus* n. sp., *Hypsibius dujardini*, *Itaquascon truncatus*, *Macrobiotus areolatus tonollii*, *M. cf. echinogenitus*, *M. islandicus*, *M. richtersi*, *M. sp. (simplex stage)*, *Milnesium tardigradum*, *Minibiotus intermedius*, and *Pseudechiniscus sullus*. *Macrobiotus* dominates this collection (86% of the specimen captured). No significant relationship between moss genera or tree species was found in this study. This study showed that tardigrade distributions correlated inversely with precipitation. Suggestions for tardigrade distribution and diversity are also discussed.

100

GAUGLER, MICHAEL AND DIANE NELSON. East Tennessee State University - Marine interstitial tardigrades of Huntington Beach State Park, South Carolina

A study was conducted to determine the spatial and temporal distributions of marine interstitial tardigrades at a sandy beach. Samples were taken in October 1997 and July 1998 in the exposed intertidal zone during low tide. A PVC cut-away corer was used to collect samples in increments of 10 cm to a depth of -40 cm at three beach elevations (low, mid, and high). A freshwater washing was used to remove tardigrades from the sample. Specimens were mounted under a coverslip and identified to the species level. Statistical analysis determined the presence or absence of significant differences within and between sampling seasons.

101 KARRIKER, LAURA AND EDWARD F. MENHINICK. Dept. Biology, University of North Carolina at Charlotte, Charlotte, NC 28223. - Gill transfer of food by freshwater mussels.

Mussels feed by bringing water containing suspended material into their mantle cavity and straining it through their gills. Trapped particles are transferred to food grooves where they are carried to the mouth or are expelled. This movement of particles was studied. Mussels collected the food in mucous strands, rather than as individual "free" particles. The strands were transferred by cilia along the inner and outer surfaces of the gills in a direction parallel to the gill bars. Transfer rates of 190 $\mu\text{m}/\text{sec}$ (11 mm per min) were typical. The strands were then carried to the food grooves which in the species studied did not consist of semi-enclosed tubes as is often indicated in the literature, but rather as double rows of ciliated knobs located along the outer edges of the gills. The strands were then either carried to the labial palps for transfer to the mouth, or were carried to a "dump site" where they were released into the mantle cavity for subsequent expulsion.

102 JOHNSON, JASON W. AND STEPHEN C. LANDERS. Dept. Biological Sciences, Troy State University - Food plaque digestion and elimination in the ciliated protozoan *Hyalophysa chattoni*.

The ciliated protozoan *Hyalophysa chattoni* is an external symbiont of the grass shrimp *Palaemonetes pugio*. Upon molting, the ciliate transforms into a feeding trophont that ingests exuvial fluid from the host's exoskeleton. We have studied digestion in this ciliate by labelling the developing food vacuoles with the black dye nigrosin. When the trophont later divides to produce daughter tomites, the ingested nigrosin is incorporated into the food reserves of the cells. After the tomites settle on a host shrimp, these darkened food reserves usually are digested and disappear. Heavily-labelled food reserves are retained, however, and appear in the subsequent feeding stage. These labelled vesicles, presumed at this stage to be autophagic vacuoles, do not merge with the newly-developing food vacuoles and are isolated to the peripheral cytoplasm. Further, the next generation of daughter cells seldom contain the labelled vesicles, but instead contain unlabelled food plaquettes. We have observed dark residual bodies within the divisional cyst that are apparently left over from daughter tomitic formation. The presence of the residual bodies presents a mechanism by which this protozoan may eliminate undigestible material, as defecation in this species is as of yet undescribed.

- 103 GREENE, JUDITH L., J. WHITFIELD GIBBONS AND NAT B FRAZER Savannah River Ecology Laboratory, University of Georgia, Aiken, SC 29802 - The common snapper, *Chelydra serpentina*, in southeastern wetlands.

Aquatic and semi-aquatic turtles are a substantial component of southeastern wetlands. The largest of these turtles, throughout most of its range, is the common snapper, *Chelydra serpentina*. It is long-lived (25+years), slow to reach maturity (10-15 yrs.) and one of several freshwater turtles in the U.S. that are harvested for food. Trapping has reduced some common snapper populations almost to extinction, leading to concern about the time required for local populations of a slow maturing vertebrate with low fecundity to recover from such a stress. The geographic range of the common snapper (east of the Rockies from Canada to Central America), coupled with the commercial assaults on some populations, makes it an appropriate species for comparative studies on its ecology and life history. Since 1967, this species has been studied in a variety of wetlands in west-central SC. Over 1000 common snappers have been captured, including 451 original and 641 recaptures. Trapped turtles were released after being uniquely marked, measured and other relevant data recorded. The largest male weighed 15.4 kg and was 40 cm in carapace length. The largest female weighed 10 kg and was 35 cm in length. Clutch size varied from 13 to 55 eggs. Nesting occurred from mid-April to mid-June and no multiple clutches were observed within a year. Activity decreased in colder months, but turtles were active in periods of mild weather throughout the winter. Snapping turtles were found in a variety of wetland types but prefer shallow, slow-moving or still water to swift, unvegetated areas. Basic ecological information is necessary to make sound conservation and management decisions for this species which faces trapping pressure and modification and fragmentation of its remaining habitat.

- 104 MCCARTNEY, GAVIN A., GEORGE R. CLINE, AND ROGER SAUTERER. Jacksonville State University, Jacksonville, AL - Population Genetics of the Gray Treefrog, *Hyla chrysoscelis*: Genetic Similarity Among Proximal and Distal Sites

Gene flow in frogs is related to dispersal ability. While some species or populations are very likely to disperse, others may be more sedentary. In general, gray treefrogs show little inclination to move. Roble (1979) reported juveniles dispersing up to 1.2 km from their natal ponds in Kansas. This limited dispersal suggests that gray treefrogs should show high variability among populations, with genetic similarity being negatively related to distance among the sites. In this study, we examined four populations of gray treefrogs. Two populations are within 200 m of each other, while the remaining two populations are about 30 km to the NE, and N, respectively. Six enzymes (PGI, PGM, LHD, IDH, MDH-1, MDH-2) were examined by starch gel electrophoresis and isoelectric focusing. The results suggest low levels of heterozygosity within a population and little variation between distant populations. LDH and IDH are monomorphic, while MDH-1 and MDH-2 are polymorphic. MDH-1 may have up to 3 alleles, while MDH-2 has two alleles. IDH and PGI have not yet been resolved.

- 105 MOHR, JEFFREY R.¹ and MICHAEL DORCAS.² Savannah River Ecology Laboratory.
¹Department of Biology, Furman University, Greenville, SC 29613 and ²Department of Biology, Davidson College, Davidson, NC 28036 - A Comparison of Anuran Calling Patterns at Two Carolina Bays in South Carolina.

While general breeding seasons are known for many anuran species, temporal details of calling activity with the breeding season have been poorly described. Using an automated recording system, we compared the temporal calling patterns of five species of anurans [*Hyla cinerea* (green tree frog), *H. gratiosa* (barking treefrog), *Rana catesbeiana* (bullfrog), *R. clamitans* (green frog), and *Acris gryllus* (southern cricket frog)] between two different wetlands of the Savannah River Site, South Carolina. We recorded *A. gryllus* calling at all times during the day at both sites. Treefrogs (*H. cinerea* and *H. gratiosa*) only called during the early evening and *R. catesbeiana* and *R. clamitans* called primarily during the early morning hours. Intensity was similar between sites for treefrogs and for *R. clamitans*; however, calling intensity for *R. catesbeiana* and *A. gryllus* differed between the two sites. Presumably, this variation reflects population size differences between the two wetlands and is likely related to differences in vegetation. Results of this study demonstrate variation in calling activity among species and between similar wetlands. Understanding such variation is essential for studies of anuran reproductive behavior.

- 106 ADAMS, JASON AND GEORGE R. CLINE. Jacksonville State University, Jacksonville, AL - Similarity Analysis of Amphibian Calling Communities

The North American Amphibian Monitoring Program (NAAMP) developed standard protocols for assessing anuran population change. One of the methods used was the Wisconsin Call Index (WCI) to measure the relative abundance of frogs based on their calling intensity. The WCI ranges from 0-3, with three being a full chorus. We calculated the average call intensity for a species by summing the WCI value for each day that a species called, and divided this sum by the total number of calling days for that species. The relative calling intensity for a species at a given pond was calculated by dividing the average call intensity by the sum of the average call intensities for each species at the site.

We used Stander's Index of Community Similarity (SIMI) to compare anuran communities at ponds on Main Post of Fort McClellan, Alabama. This index is usually calculated as $SIMI = (\sum p_i y_i) / ((\sum p_i^2)(\sum y_i^2))^{1/2}$. For this analysis, p_i and y_i are the relative calling intensities for species i in communities p and y . SIMI values for 8 anuran communities ranged from 0.569 - 0.981. Highest values were found when comparing sites from similar altitudes or hydric regimens.

- 107 COUCH, JAMES AND GEORGE R. CLINE. Jacksonville State University - Seasonal and Diel Calling Patterns in Three Northeastern Alabama Anuran Communities.

Seasonal patterns in anuran calling have been well documented in the literature, but few attempts have been made to study diel patterns in calling. We looked at seasonal and diel calling patterns in three anuran communities in Northeastern Alabama. Anuran communities ranged from 7-13 species, representing five Families. The same general seasonal pattern is readily observed at all three sites, but each site has unique start-stop dates. These patterns appear to be driven by differences in microhabitat and abiotic factors between the three sites. Diel patterns could also be observed. Prolonged breeders like Pseudacris crucifer are most active from dusk to midnight. True frogs like Rana utricularia call all night, but their calling intensity increases after the initial nightly chorus declines. Explosive breeders like Bufo americanus call at constant levels most of the night, and sometimes into the day. We discuss possible factors that contribute to this partitioning.

- 108 LINDLEY, BRIAN AND THOMAS K. PAULEY. Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - Study of the natural history for the northern spring salamander *Gyrinophilus porphyriticus porphyriticus* at the Westvaco Wildlife and Ecosystem Research Forest in Randolph County West Virginia.

Natural history characteristics of *Gyrinophilus p. porphyriticus* were examined in four streams in the Westvaco Wildlife and Ecosystem Research Forest (WVERF) in Randolph County, West Virginia. Each stream site consisted of two-25m transects and were monitored once per month from August 1997 through November 1998 for biological data such as size classes and prey items of adults and larvae. Adults and larvae were marked by toe clipping for mark-recapture data. Environmental data collected at each site included substrate preference by adults and larvae, stream widths and depths, and several environmental parameters measuring habitat conditions and water quality. Comparisons of biological and environmental data of the study streams were made to determine selection differences of habitat for *Gyrinophilus p. porphyriticus*.

- 109 SPANOVICH, STACEY. Appalachian State University - Energy allocation in Three Lizard Species during Tail Regeneration.

One important evolutionary problem facing all organisms is the choice of how to allocate available energy. Energy can be used for growth, maintenance, and/or reproduction. In most organisms calories left over from a consumed meal will be stored as fat. This energy can later be withdrawn and used however most important to the animal. Lizards store fat in various organs, but the tail appears to be the most common storage site. This most common storage strategy can come into conflict with other demands. If the lizard loses its tail to escape a predator, the energy storage organ is also lost. Long-term responses to tail

autotomy should vary with the amount of energy stored in the tail., Lizards that lose substantial fat reserves with tail loss might be forced to regenerate and restock their tail before any other energy utilization option is possible. Lizards that invest little fat in their tail would be expected to allocate energy the same ways before and after tail autotomy. This project compares fat storage in the tail, regenerated tail, liver, fat bodies, and carcass of three very different species of lizards before and after tail autotomy. These results will provide valuable information about energy allocation and evolutionary strategies of these animals.

- 110 HUMPHRIES, W. JEFFREY AND THOMAS K. PAULEY. Dept. of Biological Sciences, Marshall University, Huntington, WV 25755 - Population demography and habitat utilization of the eastern hellbender, *Cryptobranchus a. alleganiensis*, in Pocahontas County, West Virginia.

The eastern hellbender (*Cryptobranchus a. alleganiensis*) is considered uncommon in most of its range due to degradation of stream and river quality. Little is known about the current distribution or the health of populations in West Virginia. This study aimed to answer questions about population demography and habitat use, including density, sex ratios, morphometrics, breeding periods, reproductive success, home range, and seasonal activity. Physical features of the habitat of hellbenders were also studied. I performed a mark-recapture study within a 250 m portion of the West Fork of the Greenbrier River in Pocahontas County, West Virginia. Hellbenders were captured at night while they were active or during the day by turning rocks. Forty-one hellbenders (29 within the site) were marked using permanently implanted P.I.T. tags injected dorsally in the base of the tail. Twenty capture occasions were made between April 24th and October 10th, 1998. Capture locations as well as distance since last capture were plotted using a grid system. Hellbenders captured were measured for total length, weighed, sexed, and their hiding rock (if applicable) was marked and measured. Nocturnal activity of hellbenders was highest during early summer. The sex ratio was nearly 1:1. Females (mean 48.8 cm) had significantly greater total lengths than males (mean 41.8 cm). Females (mean 600 g) were also significantly heavier than males (mean 393 g). Preliminary abundance estimates indicated between 30 and 39 hellbenders within the study site with 95% confidence using a closed population model.

- 111 PAULEY, BETH ANNE AND THOMAS K. PAULEY. Dept. Biological Sciences, Marshall University, Huntington, WV 25755. The association of *Plethodon nettingi* with emergent rocks.

Plethodon nettingi was listed as a threatened species in 1989 by the U.S. Fish and Wildlife Service. Its total range is within five counties in eastern West Virginia. There are fewer than 60 disjunct populations known. Most populations are above 3,000 ft. and are associated with emergent rocks or narrow ravines lined with Rhododendron. This study examined environmental factors associated with emergent rocks that might regulate the microhabitat of *P. nettingi*. Four sites, two with *P. nettingi* and two without *P. nettingi* were studied. At each site, four transects extended in each cardinal direction from the center of emergent rocks. Environmental data collected at each site included air temperature, soil temperature, relative humidity, soil moisture, soil pH, litter mass, and litter moisture. Litter mass and litter moisture were found to be significantly greater in the *P. nettingi* microhabitat.

- 112 RAIMONDO, SANDRA AND THOMAS K. PAULEY. Marshall University, Huntington WV 25755 - Potential shifts in salamander diets as indirect effects of gypsy moth pesticides.

Chemical and biological pesticides are frequently applied to entire forests in an effort to decrease defoliation by gypsy moths. The effect of two pesticides, Gypchek and *Bacillus thuringiensis* (*B.t.*) on non-target insects, birds and salamanders is being studied in a long-term project funded by the U.S.D.A. Forest Service. Since the primary food of salamanders is insects, changes in the insect community as a result of these pesticides may cause shifts in foraging and food consumption of salamanders, which may result in reduced stored fat and decreased reproductive success. Six species (*Desmognathus fuscus*, *D. monticola*, *D. ochrophaeus*, *Plethodon cinereus*, *P. glutinosus*, *P. hoffmanni*) were collected from study plots in Pocahontas Co., West Virginia between 1995 and 1998. The stomach contents of these specimens were examined to determine if dietary shifts occurred after pesticides were sprayed in 1997 as well as between nine study plots (3 Gypchek, 3 *B.t.* and 3 non-treatment). Intraspecific comparisons for all species were made to determine if dietary shifts occurred between plots as well as from pre-treatment

to post-treatment years. Data collected in 1997 did not show significant dietary shifts for any species between treatment plots or between pre-treatment and post-treatment years. Based on these results, we were unable to show any indirect effects of pesticide application on salamander foraging in 1997.

- 113 CAMPER, JEFFREY D. Dept. of Biology, Francis Marion University, Florence, SC 29501-0547 - Forest management practices and herpetofaunal diversity in the South Carolina sandhills.

The Sand Hills State Forest and the Carolina Sandhills National Wildlife Refuge encompass approximately 37,200 ha of longleaf pine forest in northeastern South Carolina. Four sites were sampled from 1995-1998 on the state forest and four sites were sampled on the refuge during 1996. Habitats sampled were longleaf pine forest, riparian forest, and temporary and permanent wetlands. One sampling site was set up in each one of these different habitats on the refuge to serve as controls. The same habitats were sampled in the state forest with forest management treatments including fragmentation at the longleaf pine forest site, selective logging at the riparian forest site, clear cutting at the permanent wetland, and stump removal at the temporary wetland. Despite the sampling bias in favor of the state forest, the refuge yielded many more species and captures of salamanders. Data from before and after clear cutting will be presented for one site as well as species diversity estimates for all sampling sites.

- 114 PAULEY, THOMAS K., AND JOSEPH C. MITCHELL. Dept. Biological Sciences, Marshall, WV 25755 and Allegheny Institute of Natural History, University of Pittsburgh at Bradford, Dept. of Biology, University of Richmond, Richmond, VA 23173 - Potential Effects of Silvicultural Practices and Deer Densities on Forest Salamanders in Northwestern Pennsylvania.

We examined the combined effects of silvicultural practices and established deer densities on species composition and surface abundance of forest salamanders in four deciduous hardwood sites in or near the Allegheny National Forest in northwestern Pennsylvania. Each site was partitioned by fences into 4 sections, one with 64 acres and 3 with 32 acres. Each section had three silvicultural treatments, clearcuts, thin-cuts (= shelterwood), and no treatment. Deer densities varied in each silvicultural treatment from 1/32 acres, 1/64 acres, 2/32 acres, and 4/32 acres. Five salamander species with 756 specimens were observed in total. Clearcuts had fewer salamanders than thin-cuts and untreated areas but species composition was the same in all treatments. Established deer densities did not alter species composition or surface abundance of salamanders among treatments. The lack of effects may be due to low deer density or salamander resilience to their impacts on vegetation. This study was supported by the USDA-Forest Service Northeastern Research Station Forestry Sciences Laboratory in Irvine, PA.

- 115 BECK, MICHELLE L., MATTHEW P. ROWE, AND R. WAYNE VAN DEVENDER. Dept. of Biology, Appalachian State University, Boone, NC 28608 - Defensive escalation in vipers: the effects of ecdysis and feeding.

Serpents have captivated humankind for millennia, provoking fascination, fear, and a great deal of folklore. One prevalent myth is that snakes, especially venomous ones, are more dangerous when they, themselves, are more vulnerable; i.e., when the snake is injured, gravid, cold, in shed or burdened by having just eaten a large meal. Recent studies have shown that at least one of these conditions, cool body temperature, actually causes rattlesnakes to be more, rather than less, hesitant to rattle and to strike. Here, we seek to test the influence of ecdysis (shedding) and feeding on the defensive behavior of vipers in the subfamily Crotalinae, including rattlesnakes (*Crotalus sp.* and *Sistrurus sp.*), copperheads (*Agkistrodon contortrix*), and cottonmouths (*A. piscivorus*). A repeated-measures design was used to test each snake in the following three conditions: when its eyes were occluded during ecdysis; immediately after ingesting a meal that exceeded 30% of the snake's unfed mass; and a control when the snake was neither in shed nor gorged. During each trial, a predator model (heated internally) was used to threaten the snake in a manner meant to simulate an escalating encounter with an enemy. For example, we started by looming the model to within 72 cm of the snake, then moved to looming to within 48 cm, then 24 cm, etc., until eventually touching and then pinning the snake with the model. Each trial was videotaped. Variables measured from the tapes included responses such as latency to rattle (or vibrate the tail), latency to strike, distance at which the model elicited these defensive behaviors by the snake, and whether or not the snake attempted to retreat. Trials were still being run and videotapes analyzed when this abstract was submitted. Results should determine whether gorged or shedding snakes are indeed more irascible.

- 116 CARTER, JACQUELINE, AND GEORGE R. CLINE. Jacksonville State University, Jacksonville, AL. Sexual Dimorphism in Four Subspecies of the Box Turtle, Terrepenne carolina.

Box turtles, Terrepenne carolina, are terrestrial members of the Family Emydidae. Box turtles exhibit sexual dimorphism in eye color and plastron shape, but other forms sexual dimorphism in shell shape have not been reported. It is possible that natural selection could drive shell shape in different directions in males and females since the reproductive fitness of each sex is subjected to different selective forces. Nine external shell characters were measured, and shell height asymmetry (carapace height anterior - carapace height posterior) was calculated for 857 specimens representing four subspecies (T. c. carolina, T. c. baum, T. c. major, T. c. triunguis). Specimens from Auburn University, Jacksonville State University, University of Georgia, University of South Alabama, and the Carnegie Museum of Natural History were used in this study. Preliminary results indicate that the relative height of the anterior and posterior portions of the shell are sexually dimorphic. Females tend to be higher in the back, while males tend to be higher in the front. Allometric growth differences are also discussed.

- 117 SHULL, J. KENNETH, JR. Appalachian State University. Unexpected indicators of success in biology.

Active participation and questions in class and laboratory are clear indicators of interest and success in any given class. In a series of experiments it is shown that other factors can also be indicators of success, but these factors apparently have nothing to do with the subject or interest in the subject. At the first meeting of a botany class for biology majors in which there were 98 students the students were asked to sit wherever they wished at the second meeting and were to sit there for the remainder of the semester. The grades for the examinations were compared to where the students chose to sit in the classroom. There was a direct correlation between how close the students sat to the front of the classroom and the grades they made. Those who sat in the first two rows averaged more than one letter grade better than those who sat in the back two rows.

In a second experiment students were asked to answer the following question on a genetics examination: "How many U.S. senators does the state of North Carolina have?" There was no point value to the question, but it was stressed that they were expected to answer. Those missing the question equaled 28.2% of the respondents (guesses ranged from one to one hundred). The students who correctly answered the question averaged one letter grade better than those who missed the question.

It is probable that these two variables indicate how interested students are in the world around them and how they approach the learning environment; the more attention that students pay to everything around them the more likely they are to be successful in many endeavors.

- 118 WEIGANT, PATRICIA L. Peace College - A critical thinking laboratory exercise in an undergraduate ecology course: using an Excel spreadsheet to model calcium nutrient cycle in a prairie ecosystem.

Critical thinking skills in undergraduate students can be encouraged through exercises which require a step-wise construction of an ecosystem model. A method is given for an ecology laboratory exercise using Excel, a common spreadsheet program, to model the calcium nutrient cycle in a prairie ecosystem. Students must first construct a static energy flow diagram, define compartments, set initial values, determine appropriate flux levels, and then "program" the model (construct flux equations). Mathematical skills no more advanced than algebra are required. Providing guidance and examples while refraining from offering too much help is the instructor's typical role, letting students progress from the floundering stage, to an intuitive model, to a functional model. When class confidence is low, ensuring that students construct their spreadsheets in a parallel fashion allows them to get comparable results. Team or group efforts are encouraged. The model is allowed to "run" (iterate) for forty years, though because it is a closed ecosystem model, equilibrium is typically reached after about 20 years. Using the Excel chart feature provides positive reinforcement through impressive-looking results, and allows easier interpretation of the model because of its graphical nature. More advanced students can construct independent energy-flow models using data tables from the literature.

- 119 SAUTERER, ROGER A. Jacksonville State University, Jacksonville, AL - Exobiology courses: A vehicle for demonstrating connections between biology and the other sciences.

Courses in exobiology offer the opportunity for students to explore both the frontiers of life science and the interrelationships between astronomy and the geosciences to the development and evolution of life. Popular science fiction films, television shows, and novels have generated a high level of interest in the subject of exobiology, yet also generate many misconceptions and ideas that are poorly supported by scientific evidence.

Key concepts deserving emphasis in an exobiology course include planetary formation and evolution, the development of potentially life-bearing planets, theories on the origin of life, the development of metabolic strategies, the biology of extremophiles and their implications for extraterrestrial life, the life-bearing potential of planets in the Solar System, and what we could learn from the discovery and analysis of extraterrestrial life. An exobiology course can easily be expanded to discuss the origin and evolution of intelligence, the possibility of intelligent extraterrestrial life, and consequences of contact with intelligent extraterrestrials on our social systems. Although most exobiology courses are taught by astronomy faculty and have an astronomical emphasis, I will propose an outline and summary of key concepts for an exobiology course emphasizing the biological aspects and describe potential texts and other resources. A properly organized exobiology course can encourage both student discussion and integration of a broad range of biological knowledge into "the big picture".

- 120 DURRANT, GARY. Department of Biology, Jacksonville State University, Jacksonville, AL 36265 - Using Arc/View GIS Software in Biological Education.

Geographic Information Systems (GIS's) are an important technology for biological research and education, but relatively few biology teachers and professors are trained in their use. There are several ways that biologists can get training in this technology. ESRI Inc., the manufacturer of Arc/View GIS software, has short training sessions around the country (www.esri.com). These courses are taught year round, including the summer months. Another alternative is to enroll in the University of North Alabama's GIS Certificate Program, which is taught by a combination of distance learning and weekend laboratory sessions. For schools and universities, ESRI offers significant educational discounts (\$250/workstation). A less expensive way to get started in GIS is to use a textbook/CD-ROM package entitled: *Getting to Know Arc/View GIS: The Geographic Information System (GIS) for Everyone*. Prentice Hall. ISBN: 0138954674. 1998. The CD-ROM contains an autotutorial training program in Arc/View GIS. The CD-ROM contains an educational version of Arc/View GIS, and it is limited to using the datasets provided on the CD-ROM. Students are guided through a series of lessons and exercises which will introduce them to what a GIS is, and how it can be used in the environmental sciences. This package is aimed at advanced high school, and beginning college students in the environmental sciences, and its price is much lower than the fully functional versions of Arc/View GIS (\$50).

- 121 McGUIRE, ROBERT F. University of Montevallo -Applying algebra to genetic exercises.

Algebraic techniques may be used to solve genetic exercises. In the inheritance of a single trait, three genotypes (YY, Yy, and yy) and six crosses (YY x YY; yy x yy; YY x yy; YY x Yy; yy x Yy; and Yy x Yy) are possible. Solutions of these crosses are based on algebraic multiplications, such as $(a + b)(x + y) = ax + ay + bx + by$. The six monohybrid crosses are solved in four steps: genotypes of the parents of the cross, genotypes of the gametes of these parents, algebraic product of these gametes (the F₁ genotypic ratio), and the F₁ phenotypic ratio for the specific trait. Genotypic ratios of these classical crosses are, respectively, all YY; all yy; all Yy; $1/2Yy + 1/2YY$; $1/2Yy + 1/2yy$; and $1/4YY + 2/4Yy + 1/4yy$. Using the above information, variations of monohybrid crosses such as finding the F₂ from Yy x yy or calculating the outcome from testcrossing the results of Yy x Yy may be solved. Solving a dihybrid cross requires separating it into two monohybrid crosses, finding the genotypic ratios of these monohybrid crosses, and taking the products of these monohybrid crosses to a dihybrid answer.

- 122 HOOKER, VALERIE E. AND TERRY D. RICHARDSON. Department of Biology, University of North Alabama, Florence AL 35632-0001 - A life history comparison of *Viviparus georgianus* found in a temporary riparian wetland and a permanent stream.

Viviparus georgianus is a common freshwater prosobranch snail inhabiting permanent streams and rivers in the southeastern United States. Oddly, it has also been reported from a temporary wetland in northern Alabama. To compare life histories in both environments, we examined populations in a permanent stream and the temporary wetland in Limestone County, Alabama. The temporary site was dry June through October and small areas of standing water appeared briefly only after extended periods of heavy rain. Monthly samples indicated mean adult and embryo densities, and mean biomass were significantly lower in the temporary habitat. There was, however, no significant difference in fecundity. Male: female ratios were almost 1:3 at the temporary site, but were essentially 1:1 at the permanent location. Both male and female snails at the

temporary site matured at sizes smaller than at the permanent site. Because of extended dry periods in the temporary habitat, snails may experience limited foraging opportunities and higher mortality. As a result, snails at the temporary site mature at smaller sizes, yet maintain fecundity by sacrificing growth.

- 123 JUSTICE, GREG, LUTHER BROWN, AND SUSAN ELLIOTT. Center for Field Studies, New Century College, George Mason University, Fairfax, Va. 22030 – An analysis of beach debris from Andros Island, Commonwealth of the Bahamas.

Flotsam was collected along a 100m stretch of beach adjacent to the tide line, at two sites on Andros Island, Bahamas. Flotsam was separated into major groupings of Plastic, Glass, Rubber, Metal, Paper, Wood and Cloth in accordance with past surveys done on the same subject. Each individual item was then identified, counted and recorded. A total of 557 pieces of flotsam were collected, 201 from site 1 and 376 from site 2. Plastic was the most common material making up 78.20% of pieces recorded. Glass and wood were the second most common forms. Comparisons of the data collected at sites 1 and 2 were made with data collected from previous surveys done on Andros Island, Florida coastlines and Ducie Atoll and similarities and differences are discussed. The original uses of identifiable objects are also discussed in light of their sources, and their impact on Andros Island.

- 124 DOHOGNE, MOLLI, KRISTINA JONES, AND LUTHER BROWN. Center for Field Studies, New Century College, George Mason University, Fairfax, VA 22030– A vertical profile of a freshwater blue hole on Andros Island, Commonwealth of The Bahamas.

Blue holes are naturally occurring karst wells that are common on Andros Island. The blue hole known as Ides of March is one of the deepest on Andros, with a vertical drop of 110 m. In July of 1998, we studied the physical and chemical properties of Ides of March along a vertical transect that extended from the surface to the bottom. Parameters that were measured at increasing depths included temperature, conductivity, salinity, dissolved oxygen, pH, sulfide, phosphate, nitrate, carbon dioxide, and ammonia concentrations. Ides of March was composed of freshwater floating on top of salt water. The transition zone began at approximately 25 m, and extended to 30 m. Dissolved oxygen was absent below this pycnocline. Carbon dioxide increased dramatically below the transition zone, reaching a maximum of 35ppm at a depth of 110 m. Sulfide levels reached 10ppm at a depth of 62 m, and were greatest (>20ppm) at 110 m. Phosphate, nitrate, and ammonia ions were virtually undetectable. pH dropped from 8.36 at the surface to 7.27 at the bottom.

- 125 HANLON, SHANE AND RICHARD NEVES. Virginia Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061 – Comparison of survival in juvenile mussels (*Lampsilis fasciola*) released into a fish hatchery raceway.

Recent efforts to restore depressed or extirpated freshwater mussel populations have focused on artificial propagation as an effective and practical conservation strategy. Although artificially cultured juveniles have been produced and released to the wild, no study has investigated the best time of year to release these juveniles. In this study, juveniles of *Lampsilis fasciola* (wavyrayed lampmussel) were artificially propagated in the laboratory and subsequently released into a fish hatchery raceway during June and September. Growth and survival data were collected over several months for each release to determine the best time of year for juvenile release. Juveniles released in June experienced a gradual decline in survival rate, with 50% survival after 72 days and stable survival thereafter. Juveniles released in September experienced high mortality within the first month, and survival was only 9% after 52 days. Juveniles released in June exhibited considerably greater growth than those released in September. From these results, we suggest that the best time for release of propagated juvenile mussels should be at the beginning of the growing season in late spring (June).

- 126 SPICER, JENNIFER S. AND ERIC F. PAULEY. Dept. Biology, Coastal Carolina University, Conway, SC 29528 - Microtopography and cover crop effects on vegetative colonization of a created wetland.

Wetlands destroyed or damaged by human activity may be replaced by the restoration or preservation of existing wetlands, or through the creation of new wetlands. When attempting to create a wetland, it is important to identify factors which influence the development of hydrophytic plant communities. We examined the effects of microtopography and seeding with a grass mixture on the prevalence of hydrophytic vegetation at a wetland creation site in Georgetown County, South Carolina. The influence of these factors on percent cover of hydrophytic vegetation depended upon where the plots were located with respect to standing water. In plots closest to ponded areas, reducing microtopography decreased the percent cover of obligate and increased the percent cover of facultative species. In plots farthest from ponded areas, we found the same effect in treatments that combined reducing topography and seeding, although seeding with a cover crop alone had no significant effect in any plots. The use of excavation machinery in wetland creation may produce complex microtopography. Our study suggests that reducing this microtopography negatively affects development of hydrophytic vegetation in saturated soils.

- 127 GRAY, MARGARIT. Erskine College and Clemson University - Employing the Algal Growth Potential Test to determine the effect of *Corbicula fluminea* on an aquatic ecosystem.

Little research has been conducted to see what happens when the benthic community of an oligotrophic lake is enriched. In the bottom-up view of ecosystem structure an increase in nutrients will increase ecosystem productivity and biomass. Clams, by filter-feeding remove material from the water column and concentrate it as feces or pseudofeces, potentially enriching the sediment. The Algal Growth Potential Test (AGPT) was employed to show if the presence of the clam *Corbicula fluminea* enriched the sediment of an oligotrophic lake. Twenty containers containing clams and twenty containers with no clams were placed into a larger container, through which lake water was continuously pumped. After a month, clams were removed from containers and the Algal Growth Potential Test was performed on samples from each container. The algal growth potential of water samples in containers with clams was greater than samples taken from containers without clams. The nutrient level in the containers with clams was higher than in containers without clams. This correlated with phosphorus tests performed on water samples from each container.

- 128 NEWMAN, MARIE C.¹ AND EUGENE G. MAURAKIS². ¹Hampden Sydney College, VA 23943 and ²Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220 and University of Richmond, VA 23173 - Breeding behaviors in *Notropis alborus*.

Breeding behaviors (establishment of male territories, aggression between males, and spawning) in *Notropis alborus* (whitemouth shiner) were identified with direct field observations and review of videotapes of activities recorded in Mines Creek (Roanoke River drainage), Virginia in 1997. Male *N. alborus* established and defended individual territories after a period of combat and jockeying for position over substrate. Five forms of aggressive behaviors (non-contact head displacement, non-contact body displacement, chase, lateral head and body butts, and parallel swim) were identified between male *N. alborus*. Spawning occurred over sand and gravel at water temperatures of 27-28 C. Six sequential categories of male and female interactions that led to spawning were identified in *N. alborus*: Interim (behavior of a male in his territory); female Approach (behavior of a female towards an interim male); male Approach (behavior of interim male after female's approach); Alignment (orientation of male and female over substrate); Clasp (flexure of male's caudal peduncle and fin over back of female); and Dissociation (behavior of female and male after clasp). Categories of spawning behaviors in *N. alborus* fit descriptions of spawning in *Notropis procyne*, and may provide an appropriate framework for describing spawning behaviors in other members of the *N. procyne* species-group.

- 129 BARMORE, JONATHAN G¹., DAVID C. HEINS¹, AND FRANK JORDAN². ¹Department of Ecology, Evolution, and Organismal Biology, Tulane University, New Orleans, LA 70118 and ²Department of Biological Sciences, Loyola University, New Orleans, LA 70118 - Comparative behavior of two potentially competing stream fishes.

This study is a preliminary investigation into the relationship between two potentially competing stream fishes. Behavioral data were collected for the Okaloosa and brown darters (*Etheostoma okaloosae* and *Etheostoma*

edwini) in the Choctawhatchee Bay drainage in northwestern Florida during the spring and fall of 1998. Sampling locations included both sympatric and allopatric populations. Behaviors observed included five distinct events (i.e., state change, inter- and intra-specific interaction, reaction to predator, and capture of prey) and five distinct states (i.e., resting, scanning, inter- and intra-specific interaction, and predator evasion) recorded during 1000 second sampling periods. Multivariate and univariate analyses indicate that the two species exhibit similar behavior patterns, although the brown darter is typically more active.

130 NELSON, DIANE R. East Tennessee State University – Observations of nesting triggerfish and burrowing blennies in the Solomon Islands.

During research trips to the Solomon Islands with Dr. Eugenie Clark in 1997 and 1998, observations were made of fish behaviors utilizing scuba gear and various underwater video cameras and 35 mm cameras. A nesting site for the ocean triggerfish was discovered and the nesting territory was mapped. There were 25 nests in the coral rubble area. Each nest measured about 1 m in diameter and 0.2 m in depth. Many of the nests were active sites with one male and one female hovering above the nest. In addition, observations were made on the behaviors of *Pholidichthys leucotaema*, also known as the “convict blenny” or “false catfish” or “mimic catfish.” Adult pairs live in burrows that they share with juveniles. The juveniles emerge at dawn in swarms and then return to the burrow at dusk. During the day, adults clean the burrow by spitting out sand and rubble. At night, they remain in the burrow; feeding behavior of the adults remains unknown.

131 GAMBLE, ROBERT J. AND DAVID G. LINDQUIST. University of North Carolina at Wilmington - Distribution of larval fishes in Onslow Bay, NC: A comparison of catches in shelf water and Gulf Stream water.

To best apply management programs to commercially important fisheries, it would be beneficial to determine whether the fished population is the only significant source population for the adults. In Onslow Bay, NC there is a possibility that larval fishes spawned in source populations to the south may be transported northerly by the Gulf Stream, allowing these larvae to settle in Onslow Bay when a Gulf Stream meander or frontal eddy enters the bay. A series of samples were collected in the spring and summer during 1996 and 1997 from locations in Onslow Bay, both at a fixed site and at the Gulf Stream front on either side. The primary sampling device employed was the Doherty light trap, with bongo and neuston net tows supplementing the collection. To determine if the water mass at the collection sites was Gulf Stream or shelf water, *in situ* methods such as CT (conductivity and temperature) loggers were used with AVHRR (Advanced Very High Resolution Radiometer) satellite images which measure SST (sea surface temperature). Results from the light trap collection over the fixed site indicate that there is a significantly higher number of larval fishes caught in Gulf Stream water than in shelf water. These results lead to the possibility that a significant portion of the populations in Onslow Bay are spawned in source populations to the south and future verification experiments can be done.

132 TZENG, MIMI W.¹, JONATHAN A. HARE², ALLYN B. POWELL² AND DAVID G. LINDQUIST¹. University of North Carolina at Wilmington¹ and NOAA Beaufort Laboratory² - Ingress of postlarval snappers (principally *Lutjanus griseus*) into the Newport River Estuary, North Carolina.

An understanding of the process of estuarine ingress of larval fishes is important for understanding the variations in abundance of adults. Along the southeastern U.S. coast, summer-spawning, estuarine dependent species have not been as well studied as winter-spawning species. Ingressing postlarval snappers were sampled with a fixed neuston net from a bridge over a channel in the Newport River Estuary in 1993 and 1998. Four species of snappers were found: *Lutjanus griseus*, *L. analis*, *L. synagris*, and *L. apodus*. *L. griseus* was the most abundant species found, at densities as high as 11 per cubic meter. Snappers ranged in standard length from 11 to 20 mm. In both years, ingress of snappers occurred between July and October, with a peak in September. A lunar pattern was found; snappers ingress primarily during new moon and secondarily during full moon. Interestingly, snappers which ingress into the estuary are not found as adults in offshore waters of North Carolina. Larvae may be transported to North Carolina estuaries from the south by Gulf Stream processes; whether these fish survive to join adult populations is unclear.

133

WOODSON, HEATHER W. and ILEANA E. CLAVIJO. Dept. of Biological Sciences and Center for Marine Science Research, University of North Carolina, Wilmington, NC 28403-3297 - Diet of coastal pelagic fishes in North Carolina: Predators of newly hatched loggerhead turtles?

Potential predation on loggerhead sea turtle hatchlings by oceanic fishes was examined in the laboratory and field during 1997. In the laboratory, four levels of response by predatory and nonpredatory fish to live and model turtles differed significantly in the number of approaches and contacts, but did not differ in reactions to model or live hatchlings by either group, validating the use of models in field trials. In the field, models were used in 24 day and night trolling trials on 12 randomly selected sampling days, with 12 trials in nearshore (<10 km from shore) and 12 trials in offshore waters, resulting in zero capture of predators. Stomach content analysis of three coastal pelagic predators, including 1198 king mackerel, 3 Spanish mackerel, and 22 amberjack obtained from recreational fishing tournaments and commercial fishermen during 1997 and 1998 showed no turtle remains. Mean percentage of empty stomachs was 51.2% and 35.5% respectively, in 1997 and 1998 tournaments. The diet of king mackerel was varied consisting of 11 fish and five invertebrate species and this fish should still be considered a potential predator on sea turtle hatchlings due to voracious feeding habits, varied diet and presence in waters where hatchlings migrate and reside.

- 134 HEINS, DAVID C. AND JOHN A. BAKER. Dept. Ecology, Evolution, and Organismal Biology, Tulane University and Department of Biology, Clark University - Evaluation of ovum storage techniques for reproductive studies of fishes.

We compared dry masses of mature oocytes and ripe eggs from *Etheostoma lynceum* and *Etheostoma caeruleum* that were stored in varying concentrations of either formalin or isopropyl alcohol. In comparison to 10% formalin, alcohol significantly reduced the weights of both mature oocytes and ripe eggs, with 25% isopropyl alcohol resulting in much smaller reductions than 50% isopropanol. Three-percent formalin resulted in smaller decreases in the masses of oocytes and eggs than 10% formalin, however, not all comparisons were significantly different. We recommend fixing specimens and storing them and gametic cells removed from them in 10% formalin. In cases where specimens or eggs in alcohol must be used in addition to material in formalin, correction factors (to formalin standard) should be developed, but the correction should not be made uncritically due to varying effects alcohol may have among samples.

- 135 HOOD, CRAIG S. AND DAVID C. HEINS. Dept. Biological Sciences, Loyola University and Dept. Ecology, Evolution, and Organismal Biology, Tulane University - Ontogeny and allometry of body shape in the blacktail shiner, *Cyprinella venusta*.

We analyzed data for ten landmarks per individual fish from a single, large sample (n = 397; 182 males, 215 females) collected in Catahoula Creek, Jourdan River drainage, Hancock County, Mississippi, to study ontogenetic changes in body shape and concomitant allometries in *Cyprinella venusta*. We assessed sexual dimorphism during ontogeny and investigated the relationship between reproductive status and ontogenetic body shape change. We found large, highly significant sexually dimorphic differences in the body shapes of males and females. The trajectories of body shape change (allometric slopes) within males as compared to females also were significantly different. Among reproductive classes, there were highly significant shape differences within males and females, suggesting that reproductive status co-varies with body shape.

- 136 GUILL, J. MICHAEL¹, DAVID C. HEINS¹, AND CRAIG S. HOOD². ¹Department of Ecology, Evolution, and Organismal Biology, Tulane University, New Orleans, LA 70118 and ²Department of Biological Sciences, Loyola University, New Orleans, LA 70118 - Female body shape variation within and among three species of darters.

Body shape data were collected for more than 600 females of *Etheostoma caeruleum*, *Etheostoma nigrum*, and *Etheostoma stigmaeum*. Each species was represented by multiple collections from geographically distinct populations. Eight landmarks per female were digitized and partial warp scores were extracted and used as shape variables in a nested multivariate analysis of variance. Highly significant differences in shape were found among species and among populations within species. The results corroborate the intuitive assumption that there should be more shape variation among species than is explained by variation within species.

- 137 JOHN T. GOODIN¹, EUGENE G. MAURAKIS², ELGIN S. PERRY³ AND WILLIAM S. WOOLCOTT². ¹Wetlands Div. EPA, 401 M St., SW, Washington, DC 20460, ²Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220 and Biology Dept., University of Richmond, VA 23173, and ³2000 Kings Landing Rd., Huntingtown, MD 20639-Species recognition for *Percina nevisense* Cope.

Analysis of character variation among populations of *Percina peltata* (shield darter) throughout its range indicates species-level differentiation between northern and southern populations. Populations in and south of the Chowan-Roanoke River drainage are *Percina nevisense* (Neuse River darter). Populations in and north of the James River drainage are *P. peltata*. These conclusions are supported by multivariate analyses of nine meristic (eight significant discriminators) and eight morphometric (seven significant discriminators) characters. Presence of cheek scales, the most prominent external discriminator in *P. nevisense*, scales above and below lateral line, scales around caudal peduncle, dorsal fin ray spines, dorsal fin pterygiophore position, and caudal peduncle depth can be used to distinguish *P. nevisense* from *P. peltata*.

- 138 JACKSON, NAKIA C.¹, RHENEISHA E. MABLE², AND HENRY L. BART JR.¹. ¹Ecology, Evolution, and Organismal Biology Dept., Tulane University, New Orleans, LA 70118 and ²Dept. of Biology, Xavier University of Louisiana, New Orleans, LA 70125- Fin proportion differences in populations of *Cyprinella venusta* (Osteichthyes: Cyprinidae) from different stream runoff regimes.

Recent studies suggest that stream flow regime influences propagule and adult body size in minnows. In this study, we examined differences in fin proportions in populations of *Cyprinella venusta* from different runoff regimes. Fin sizes were measured on mature specimens of *C. venusta* from four river systems in the southern U.S.. Fin measurements were expressed as ratios of body standard length, and arcsine transformed. ANOVA was used to test for differences among population means and sexes for many fin proportions. When sexes were analyzed separately, individuals from high runoff streams tended to have smaller fin proportions than individuals from low runoff streams. The differences may relate to hydrodynamic efficiency, with smaller fins producing less drag in swimming.

- 139 HERBST, ERIC C. AND EDWARD F. MENHINICK. Dept. Biology, University of North Carolina at Charlotte, Charlotte, NC 28223- A computerized polyclave for fish identification.

In a computerized polyclave for identification of species (random access key), characters selected by the user are entered (i.e., stream where collected, color, shape, size, meristic values), and the computer is queried to display illustrations of species matching the input information, or more characters may be entered to narrow the alternatives. Dr. John Kartesz with the Department of Botany at UNC-Chapel Hill is working on a polyclave to identify plants, and is helping UNCC to develop a fish polyclave. We are counting 20 meristic characters of the freshwater fishes of North and South Carolina (lateral line scales, dorsal spines, etc.) to enter into a polyclave. We will also be using a TV camera joined to a computer to digitize 20 coordinates of fishes (standard length, predorsal length, etc) for comparing length ratios of different parts of the fishes. Illustrations, spot distribution maps, and information from the literature will also be computerized.

- 140 BURSE, JEANINE R.¹, ANN O. CHEEK², AND HENRY L. BART JR.¹. ¹Ecology, Evolution, and Organismal Biology Dept., Tulane University, New Orleans, LA 70118 and ²Dept. of Biology, Southeastern University of Louisiana, Hammond, LA 70402- Immunohistochemical detection of Vitellogenin (Vg) in formalin-fixed livers of *Lepomis macrochirus*.

Vitellogenin (Vg) in male fish has become a popular biomarker of exposure to environmental estrogens. In fish, environmental estrogens have been shown to induce vitellogenesis and decrease testosterone production - potentially decreasing reproductive success. This study develops an immunohistochemical protocol to detect Vg induction in formalin-fixed livers. The ultimate goal of this research is to use this protocol on specimens archived in Natural History collections to assess the history of exposure to environmental estrogens. Male

Lepomis macrochirus were exposed to estrogen; Vg was detected in blood serum and liver homogenate by western blotting. Half of the livers from these specimens were fixed in formalin, embedded in paraffin, sectioned, and placed on coated slides. Immunostaining was performed using a *L. macrochirus* Vg antibody; immunoreactivity was detected by an streptavidin-biotin immunoperoxidase method after microwaving the sections in an antigen retrieval buffer. Vg seems to be detected, making this protocol an essential key in historical monitoring.

- 141 GLADDEN, JOHN AND MARK MEADE. Department of Biology, Jacksonville State University, Jacksonville, AL 36265 – Biochemical identification of channel catfish *Ictalurus punctatus*, blue catfish *Ictalurus furcatus*, and their hybrid.

In their natural habitat, channel and blue catfish spawn during different seasons. Hybrids of the two species are commonly produced artificially in fisheries but, historically, are rarely observed in the wild. Several sources suggest that hybrid catfish are commonly being produced in native Alabama waterways. Identification of channel, blue, and hybrid catfish using morphological keys is often difficult, particularly when examining fry or juveniles. Gel electrophoresis coupled with histochemical staining is a rapid and relatively inexpensive method for examining phenotypic differences among species. The purpose of this study was to determine if electrophoretic fingerprints could be used to identify tissue samples taken from either channel, blue, or hybrid catfish fry. Tail muscle tissue (~5 mg) was excised from one week old channel, blue, and hybrid catfish fry (n=10/species, ~100 mg ind wet wt) and homogenized in 1% Triton X-100 (3.1 vol/wt). Samples were centrifuged for 15 min at 45,000 RCF and the resultant supernatant removed and frozen until used for electrophoresis. Samples were analyzed using standard protocols for IEF electrophoresis and staining of soluble proteins. Protein patterns for channel, blue, and hybrid catfish fry were distinct. Major protein bands in the pI range from 3.5-5.8 were identified as species-specific markers. Preliminary analysis suggests that these marker proteins may be muscle parvalbumins, a group of highly conserved proteins commonly found in vertebrate muscle.

- 142 JOHNSON, JILL M. AND DAVID C. HEINS. Dept. of Ecology, Evolution and Organismal Biology, Tulane University, New Orleans, LA 70118 – Reproductive biology of the ninespine stickleback, *Pungitius pungitius*, from Southcentral Alaska.

The threespine stickleback, *Gasterosteus aculeatus*, has long been considered an exemplary species for evolutionary biology and ecological studies. Like the threespine stickleback, the ninespine stickleback, *Pungitius pungitius*, exhibits a circumpolar distribution and inhabits a wide variety of environments. It has been supposed that these fish serve as intermediate hosts to *Schistocephalus pungitii*, a cestode parasite related to a species that has been shown to adversely affect the reproduction of threespine stickleback. Little is known about the life history of the ninespine stickleback. We will describe the breeding season, egg production and the host-parasite relationship of *Pungitius pungitius* from Southcentral Alaska.

- 143 HOWARD, GREGORY G. AND WERNER WIELAND. Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401 – Occurrence of *Etheostoma fusiforme* in the York River basin of Virginia.

The swamp darter, *Etheostoma fusiforme* is a small Coastal Plain fish, common from Maine to Florida and along the Gulf coast to the Mississippi River. In Virginia its historic distribution is peculiar due to the absence of this species from the Rappahannock and York river basins. Changes in sea level due to melting of continental glaciers have been suggested as a reason for its absence from the Coastal Plain of these drainages. Upon discovering the swamp darter in a student's collection from the Upper York River basin we searched for this species in additional tributaries. To date we have discovered a total of two populations in tributaries of the Mattaponi River. Both localities lie within the Coastal Plain physiographic province. Thus it is likely that additional populations exist and its apparent absence may be attributed to its rare occurrence in these streams and/or the difficulty of collecting in Coastal Plain streams.

- 144 HUGHES, MELANY, RAYMOND L. PETERSEN, AND RICHARD M. DUFFIELD. Dept. Biology, Howard University, Washington, D.C. 20059 – *Plethodon cinereus* (Red-backed Salamander) trapped in leaves of the Purple Pitcher Plant, *Sarracenia purpurea* L.

While studying invertebrate inhabitants of leaves of the bog-dwelling purple pitcher plant, *Sarracenia purpurea* L., we discovered two dead *Plethodon cinereus*. The first was recovered in September 1996, at Big Run Bog in the Monongahela National Forest, Tucker County, West Virginia, when the tube being used to suction the liquid contents from the leaves became clogged with a dead salamander. The second was found on 24 March 1997 at Christner Bog in Mount Davis State Forest, Somerset County, Pennsylvania. This individual was found wedged tightly into the leaf stem, facing head down. Although the stomach of the Christner Bog specimen was empty, the leaf from which it was recovered contained 85 midge larvae (Chironomidae). The stomach of the Big Run Bog specimen held eleven ants (*Myrmica* sp.) and one midge larvae. The leaf in which this salamander was found contained fifty-nine midge larvae, six ants (*Myrmica* sp.). The extent to which *P. cinereus* forages in bogs remains to be documented. Why or how these salamanders died in the leaves is unknown. It should be noted, however, that pitcher plant leaves provide a rich food source including dead insects and larvae of several inquilines that feed on dead prey or microorganisms associated with the leaves. Sponsored by USDA-Forest Service (Eastern Region) and Howard University.

- 145 POPPY, SEAN M.¹, MICHAEL E. DORCAS², AND J. WHITFIELD GIBBONS¹. ¹Savannah River Ecology Laboratory and ²Dept. of Biology, Davidson College—Population estimate of the black swamp snake (*Seminatrix pygaea*) at a Carolina bay.

A population estimate of the black swamp snake (*Seminatrix pygaea*) was conducted at Ellenton Bay, a 10-hectare Carolina bay on the Savannah River Site in Aiken County, SC. Coverboards and minnow traps were used to capture snakes, and were checked twice daily. Snakes were marked with individual scale-clips, and data (sex, snout-vent length, and mass) were recorded before the snakes were released at the points of capture. The bay was sampled for four one-week periods each in May, June, September, and October 1998. A total of 234 individual snakes was captured, plus 26 recaptures. The population size and structure of black swamp snakes at Ellenton Bay will be described and discussed.

- 146 RYAN, TRAVIS J.^{1,2}, AND RAYMOND D. SEMLITSCH². ¹Savannah River Ecology Laboratory, Drawer E, Aiken, SC 29802 and ²Division of Biological Sciences, University of Missouri, Columbia MO 65211 – Growth, metamorphosis and maturation in a salamander (*Ambystoma talpoideum*) with a life cycle polymorphism.

Complex life cycles are composed of larval and adult phases that are morphologically and ecologically distinct, with metamorphosis as the link between the immature (larval) and mature (adult) phases. We are concerned with the timing of metamorphosis and maturation in *Ambystoma talpoideum*, a salamander that can mature without undergoing metamorphosis. We manipulated growth rates by altering the amount of food individuals received throughout larval development, and compared our results with the predictions of the Wilbur-Collins and 'fixed-rate' models of metamorphosis. We found support for the Wilbur-Collins model when growth is initially low then enhanced, and support for the fixed-rate model when growth is initially high then depressed. Differences in the expression of maturation were also attributable to larval growth conditions: individuals were more likely to initiate metamorphosis when food levels and growth rates were high later in development and more likely to mature (without metamorphosing) when growth rates were comparatively low. Our results demonstrate that the expression of metamorphosis in *A. talpoideum* is not only influenced by environmental signals (e.g., changing food levels) but that it is also affected by the timing of maturation, which itself is likely influenced by exogenous, rather than purely endogenous, signals.

- 147 BOCKOVEN, BETH Western Carolina University –Peregrine falcon restoration in the southern Appalachians.

As the USFWS prepares to delist the peregrine falcon, it is important to understand why the peregrine has not recovered in the Southern Appalachian region (northern AL & GA to northern VA & WV). The Southern Appalachian Recovery Region has not met the recovery goal of 20-25 nesting

pairs for three consecutive years although the reintroduction program is at least 10 years old. A nest site habitat availability and suitability model was created using a Geographic Information System (GIS) based on variables collected from historical nest sites (pre-1964) and presently active nest sites (since 1980). Peregrine eggs were collected and analyzed for organochlorine concentrations and eggshell thickness. The amount of eggshell thinning (0.34 mm) is well below the 17% threshold level above which population declines in peregrines are expected. Pellets, feathers and bones found at eyries were examined to determine the peregrine's prey base. Peregrines in western NC fed heavily on resident birds in the orders Passeriformes and Charadriiformes. The data indicate that the peregrines mainly hunt birds that frequent open habitat and water. Results from the habitat model and organochlorine analysis will also be discussed.

- 148 LEIDEN, YALE A.¹, M. E. DORCAS², J. W. GIBBONS¹. ¹Savannah River Ecology Laboratory, ²Davidson College – Herpetofaunal biodiversity in a Coastal Plain community: Landscape-level ecological research in Marion County, South Carolina.

A landscape-level study of herpetofauna was conducted on an 8,000 ha tract of managed forest in the Lower Coastal Plain of South Carolina for purposes of documenting biodiversity and comparing herpetofaunal communities among habitats in different stages of forest management. Intensive sampling and numerous techniques (drift fences, pitfall traps, funnel traps, box traps, automated recording systems, coverboards, general sampling, road surveys, calling surveys, minnow traps and turtle traps) were used to record species presence. During the first two years of study 7,189 individuals of 72 species were recorded from the study area, including seven species listed as "Species of Special Concern" in South Carolina (six reptiles and one amphibian).

- 149 BARRY, RONALD E. AND PETER J. MUNDY. Dept. of Biology, Frostburg State University, Frostburg, MD 21532 and Department of National Parks and Wild Life Management, P O. Box 2283, Bulawayo, Zimbabwe. Population dynamics of two species of hyrax in the Matobo National Park, Zimbabwe.

Abundances, species ratios, and age distributions of the rock hyrax (*Procapra capensis*) and yellow-spotted hyrax (*Heterohyrax brucei*) were monitored from 1992-1998 in the Matobo National Park (MNP), Zimbabwe. after sightings of hyraxes decreased through the 1980s. Hyraxes were identified to species and age class and counted at 20 permanent observation posts in April-May each year following the birth event in March. The estimate of total abundance of hyraxes was lowest in 1995 at 53,000 (95% confidence interval of 37,000 to 69,000). Populations recovered to 151,000 in 1998 (119,000 to 183,000). Estimates of *Procapra capensis* ranged from 31,000 (23,000 to 40,000) in 1995 to 63,000 (47,000 to 79,000) in 1998. *Heterohyrax brucei* ranged from 22,000 (12,000 to 32,000) in 1995 to 87,000 (70,000 to 105,000) in 1998. The species ratio varied significantly ($P < 0.01$) across years, *Heterohyrax brucei* increasing disproportionately through the 1990s. Subsequent to the birth event, juveniles comprised 18.0 (1993) to 28.1% (1995) of the *Procapra capensis* and 18.6 (1994) to 32.0% (1998) of the *Heterohyrax brucei* populations. Presumed declines and subsequent recoveries of hyrax populations appear to be responses primarily to annual rainfall and predation pressure. Temporal variation in the hyrax species ratio may be attributable in part to differential predation by and population dynamics of the black eagle, the principal predator of MNP hyraxes.

- 150 SUCKE, ALANA C. AND RONALD E. BARRY. Dept. of Biology, Frostburg State University, Frostburg, MD 21532 -Density, survival, and winter diet of the Appalachian cottontail, *Sylvilagus obscurus*, in the Monongahela National Forest, West Virginia.

Density, survival rates, and winter diet of the rare Appalachian cottontail, *Sylvilagus obscurus*, were monitored in the Dolly Sods area of the Monongahela National Forest, West Virginia, beginning in fall 1997. This area includes the type locality of the species and still appears to support an abundant population, despite apparent declines in populations in nearby western Maryland and elsewhere. Density was derived by enumeration (Minimum Number Alive) from live-trapping grids, and a fecal-pellet counting method. To estimate finite daily and monthly (28-day) survival rates, the Kaplan-Meier method was applied to telemetry data from a total of 37 individuals over 389 days. Browsed vegetation within a 1-m radius of radiolocations and fecal pellets in winter was identified and quantified, and preferences (use vs. availability) assessed with Johnson's rank-preference index. One 12-ha live-trapping grid of 49 traps yielded eight rabbits in 14 nights.

or 0.7 rabbits/ha. The daily survival rate was 0.9893 (95% confidence intervals = 0.9880 to 0.9906). The monthly survival rate was estimated as 0.7398 (95% confidence intervals = 0.7131 to 0.7666). Density estimates from a second live-trapping grid and the fecal-pellet counting method, and a preliminary evaluation of winter browse, will be reported. Estimates of density and survival, and a description of winter diet, are important indications of resource abundance and can be used as standards to which future estimates can be compared and by which the comparative "health" of a population can be assessed.

151

SCHWARTZ, F. J. Institute of Marine Sciences, University of North Carolina, Morehead City, NC - Fishes of North Carolina affected by freshwater inflows or marine intrusions.

Open, semi-annually closed or closed estuaries abound throughout the world, especially the United States, Scandinavia, South Africa, and Australia. Freshwater runoff or marine intrusions have often dramatically affected larval, juvenile or adult fish survival following such events. Increased turbidity, nutrients, pollution from cities and farms, plankton blooms, oxygen and salinity level changes, water temperature variations, pooling following droughts, food availability, and even toxic dinoflagellates have to be endured to survive. North Carolina possesses a variety of long and short open estuaries subject to natural water perturbations. After sampling all estuaries > 30 years, juveniles and sub-adults of 51 freshwater fish species, within 14 families (42% of 122 species known to inhabit estuarine watersheds) have been affected by freshwater inflows into nursery or marine habitats. Conversely, 118 larval, juvenile or adult marine fish species (17% of 687 known species frequenting estuaries or offshore oceanic waters to depths of 600 m) have been suddenly swept upstream and affected by late summer or fall marine intrusions. Lacking are studies of the effects of these perturbations to a species' physiology, population structure or its future contribution to a fishery. Inflows and intrusions, coupled with toxic dinoflagellates, may explain changes in fish populations rather than assuming population changes are the result of overfishing.

- 152 BOYCE, KELLY A. AND RONALD E. BARRY. Dept. of Biology, Frostburg State University, Frostburg, MD 21532. Habitat, thermal cover, and home range of the Appalachian cottontail, *Sylvilagus obscurus*, at Dolly Sods, West Virginia.

This century's decline of the Appalachian cottontail, *Sylvilagus obscurus*, throughout its range is presumably due in part to habitat destruction and fragmentation. Microhabitat, thermal cover, and home range for this species were measured at the Dolly Sods area of the Monongahela National Forest, West Virginia, a site of historical abundance. Eighteen individuals were radio-collared and tracked to daytime locations. Dense, heathlike vegetation, such as mountain laurel (*Kalmia latifolia*), rhododendron (*Rhododendron maximum*) and blueberries (*Vaccinium* spp.), and red spruce (*Picea rubens*) provided year-round concealment and thermal cover. Most rabbit locations were completely obscured by vegetation to a height of 0.5 m and often to 1.0 m. Microclimate temperatures 10 cm above daytime resting locations differed predictably and significantly ($P < 0.05$) from lower and higher ambient temperatures, depending on the season. Wind speed at rabbit locations was significantly ($P < 0.05$) lower than ambient. Twelve individuals provided 100% minimum convex polygon home range estimates of 4.4-16.2 ha, larger areas than expected based on the quality and quantity of vegetative cover present, and larger than MCP estimates (1.7-9.5 ha) for this species in western Maryland. These ranges, if typical, suggest the need for large, contiguous tracts of appropriate habitat to support populations of Appalachian cottontails.

- 153 TOM JONES¹, AND WILLIAM PEARSON². Division of Natural Sciences, Alderson-Broadus College, Philippi, WV 26416 and ² Dept. Biology, University of Louisville, Louisville, KY, 25226 - Predator/prey interactions among aquatic, troglobitic organisms from Mammoth Cave National Park.

Amblyopsis spelaea, *Typhlichthys subterraneus*, and *Orconectes pellucidus* are the three most common troglobitic predators in the subterranean streams in Mammoth Cave National Park. Predator density was estimated using surveys of stream segments. To reduce impact, predator size was visually estimated, with a limited amount of trutthing by capture and physical

measurement. The most abundant prey items were troglobitic isopods and juvenile predators. Prey density was estimated using rock counts and 0.3 meter plots. Predator/prey ratios varied from 0 to 1. Prior site visits had suggested substrate composition influences predator density. Substrate complexity was estimated by using 0.3 meter plots. Volume estimations were made assuming solid rectilinear shape for all objects with in the plot. A simple ratio of volume to area was calculated for each stream segment studied. Both predator composition and density varied with the complexity ratios. In general, predator density increased with prey density. Prey densities exhibited a suppression point in relation to predator numbers. This suppression point varied with habitat complexity. Predator numbers varied widely with substrate complexity. This may be the result of higher prey abundances, flooding refugia for the predators, or the increase possibility of organic matter to be trapped by the substrate.

- 154 HANCOCK, TIM¹, SEAN LOUDIN¹, TOM JONES¹, AND WILLIAM PEARSON². ¹ Division of Natural Sciences, Alderson-Broaddus College, Philippi, WV 26416 and ² Dept. Biology, University of Louisville, Louisville, KY, - Temporal and spatial variation in reproduction of aquatic, troglobitic organisms from Mammoth Cave National Park.

Eleven subterranean, stream segments were bio-surveyed from 1993 to 1998. These stream segments vary in chemical, physical, and biological condition. Reproduction, as noted by the presence of juveniles, has been temporally and spatially sporadic throughout the study period. No single site appears to act as a source subpopulation. Previous work suggests that reproduction is keyed to flooding and the resultant deposition of organic matter. Our data does show this trend but there is not a significant correlation between these variables ($R=0.68$, $n=16$). Juvenile crayfish and cavefish are not found in close approximation to each other. This may suggest strong inter-specific predation. Cannibalism has been noted in both groups. Reproductive events were not correlated to simple prey density. The interaction of hydrology, interspecific predation, and prey density result in infrequent reproductive success. This reduced reproductive output may provide adaptive pressure on troglobitic organisms to develop extended life-spans.

- 155 CLIFF R. HUPP¹, ROBERT K. PEET², AND PHILLIP A. TOWNSEND³. ¹U.S. Geological Survey, Reston, VA, ² University of North Carolina, Chapel Hill, NC and ³ University of Maryland, Appalachian Laboratory, Frostburg, MD - Fluvial Geomorphic Trends in the Bottomland Hardwood Forests of the lower Roanoke River, North Carolina.

The lower Roanoke River bottomland, on the Coastal Plain of North Carolina, supports the largest intact forested wetland in the Mid Atlantic States. This bottomland hardwood/swamp ecosystem maintains a high biodiversity and is valued by timber interests, environmental agencies, and sport fishermen. Streamflow has been regulated for nearly 50 years by a series of dams upstream from the fall line. Prior to dam closures, the bottomland experienced extensive sediment aggradation presumably arising from post-colonial agricultural practices; particularly in the upper and middle reaches of the lower river (3 to 4 m and 2 to 3 m of vertical deposition, respectively). Dendrogeomorphic analyses suggest that sedimentation rates had been increasing up to the time of initial dam closure and were suppressed during the decade (1951-60) after closure. Recently sedimentation has increased (up to 0.5 cm/yr) along the middle and lower river reaches probably resulting from scour in the upper reaches. Most deposition during the past 50 years has occurred in back swamp areas rather than upon levees, the later requiring water discharges in excess of the normal maximum dam releases to ramp coarse material (sand) upon near-channel surfaces. Changes in relative relief on the floodplain affect the local hydroperiod for a site and thus may ultimately affect woody species distribution across the bottomland. This bottomland has experienced severe shifts in both flow and sedimentation regimes over the past 200 years that have and no doubt will affect these wetland forests.

- 156 BAGGA, DAVINDERJIT K. University of Montevallo-Phytoremediation of soil and water contaminated with hazardous chemicals.

Phytoremediation is the use of plants to remove chemical contamination from soil. Emerging technology promises to be an effective and inexpensive way to clean up organic solvents, explosives, radioactive materials, and heavy metals. Frequently these contaminants are present in soil as a consequence

of human activities; such as, metal smelting, electroplating, battery recycling, wood treating, sludge dumping, and some agriculture practices. These contaminants have adversely affected soil ecology, agriculture production, and ground water quality. The current remediation techniques are very expensive and involve excavation and removal of contaminated soil, vitrification, and soil washing. Over the last ten years, increasing interest has arisen for the development of plant-based technology to remediate contaminated soil. A number of plant species have been identified which are capable of absorbing and metabolizing one or more specific hazardous waste materials, and thus removing them from the soil. By selective breeding of such plants, scientists hope to phytoremediate soil or water contaminated with hazardous chemicals.

- 157 SHARMA, G. K. Dept. Biological Sciences. University of Tennessee, Martin, TN 38238
 – Morphological and cuticular variations in *Cannabis sativa*.

Marihuana, a plant of economic and medicinal significance, is a botanical and ecological enigma. It is a relatively pathogen free, THC (tetrahydrocannabinol) producing plant. It is generally believed to be a native of Central Asia, although its precise home is still unknown. Wild or relatively wild populations of marihuana plant (*Cannabis sativa*) exist in the Himalayas (Afghanistan to Burma) up to 3,500 meters. Several populations of the taxon were studied for phenotypic variations, cuticular patterns, and adaptability in a wide variety of habitats in the wild in their native range (32° 05' N latitude and 78° 12' E longitude) at various elevations. Leaf morphology and cuticular features were affected by altitudinal variations. The data seem to suggest that it may be possible to develop relationships between some of these variations and the narcotic potency of the plant, although a biochemical analysis of the plant populations is needed to confirm this relationship.

- 158 STALTER, RICHARD. Dept. Biological Sciences, St. John's University, Jamaica, NY 11439 – The vascular flora of Ellis Island, New York.

The vascular flora of Ellis Island, a 27.5 acre (11.1 hectare) island in New York Harbor, consists of 232 species within 158 genera and 66 families. One hundred forty two species, 61.2% of the flora, are not native to New York State. Twenty-six families are comprised exclusively of non-native species. The largest families in the flora are the Asteraceae (39 species) and Poaceae (35 species). Species of extraregional origin are a major component of the natural vegetation. The high percentage of non-native vascular plants, 61.2%, is significantly higher than the non-native flora of New York State, 32.9%.

- 159 PEET, ROBERT K. Department of Biology, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599-3280 - Longleaf pine vegetation of the Carolinas and adjacent Georgia.

Highly diverse, fire-dependent longleaf pine vegetation once dominated the uplands of the Coastal Plain and Fall-Line Sandhills of the Southeast. Economic development and fire suppression have led to the loss or degradation of this vegetation over most of its original range. A lack of detailed compositional information has meant that no frame of reference has existed for conservation and restoration efforts. We systematically sampled the best remaining examples of this vegetation that remain in the Carolinas and adjacent Georgia. The resulting data have been used to develop a classification of approximately 65 vegetation types, which have been integrated into the U.S. National Vegetation Classification. Each type has been characterized by floristic composition and environmental setting. This classification provides a mechanism for inventory and evaluation of conservation areas. In addition, gradient analysis methods have been used to develop a template for restoration efforts that should be applicable throughout the study region.

- 160 BOETSCH, JOHN R.¹, VAN MANEN, FRANK T.², AND JOSEPH D. CLARK². ¹Dept. of Biology, University of North Carolina, Chapel Hill, NC 27599-3280 and ²Dept. of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, TN 37901-1071 - Modeling the geographic distribution of a rare plant, *Cardamine clematitis*: a case study in Great Smoky Mountains N.P.

An understanding of the geographic distribution of suitable habitat is a critical component of species conservation. We developed and field tested a habitat model for *Cardamine clematidis*, an endemic plant of the southern Blue Ridge Mountains, in Great Smoky Mountains National Park. Our model employed Mahalanobis distance, a multivariate measure of dissimilarity, and data from 13 geographic information system variables corresponding to 187 surveyed coordinates for the species. Tenth-hectare plots (N = 120) were stratified across the study area to independently evaluate the relationship between Mahalanobis distance and the occurrence of the study species. Logistic regression of validation data, with presence/absence as the dependent variable and Mahalanobis distance as the independent variable, indicated a significant inverse relationship (parameter estimate = -0.1323, $P = 0.0394$). A cutoff value of 13.81 was assigned that minimized misclassifications in the validation data; areas with model values below this cutoff were considered suitable habitat for the species. Although the model was a good predictor of habitat at the landscape scale, the species failed to saturate the available habitat. We point out that model validation should be an integral component of habitat modeling projects, but can require substantial field efforts. This work was supported in part by U.S.G.S. Biological Resources Division funding (IAR #1445-IA09-96-0027).

- 161 MUTH, CHRISTINE C. AND JASON B. WEST. Department of Organismic & Evolutionary Biology, Harvard University, Cambridge, MA 02138 and Department of Botany, University of Georgia, Athens, GA 30602 - Microenvironmental variation between understory patch types in a longleaf pine ecosystem.

Plants modify local resource availability and environmental conditions and may thereby influence spatial patterns of growth and regeneration. Much research has focused on the importance of canopy trees in altering resource availability. Less is known about how understory individuals modify resources and controllers, even though in some communities (e.g., dry savannas) understory cover is much greater than canopy tree cover. We investigated how common understory species affect local environmental conditions in a frequently burned, xeric longleaf pine (*Pinus palustris*) savanna. We measured a variety of microenvironmental parameters within three distinctive patch types: wiregrass (*Aristida stricta*) patches, dwarf huckleberry (*Gaylussacia dumosa*) patches, and turkey oak (*Quercus laevis*) patches. Oak patches received significantly lower light at the soil surface and had lower air and soil surface temperatures than did either wiregrass or huckleberry patches. Oak patches also had greater soil moisture than the other patch types. We attribute the distinctive microenvironmental conditions under oak to extremely high vegetative and litter cover associated with this patch type. Turkey oak provides relatively shady, cool, and moist microsites which appear to be quite unique within xeric longleaf pine savannas. Thus, this species may contribute substantially to habitat diversity in the xeric longleaf pine ecosystem.

- 162 BASINGER, MARK A.¹ AND JODY P. SHIMP². ¹Southern Illinois University, Carbondale, IL 62901 and ²Department of Natural Resources, Golconda IL 62938. Status of *Silene ovata* Pursh in the eastern United States, with particular reference to Illinois.

Silene ovata is a perennial member of the pink family that is scattered throughout the eastern United States. *S. ovata* is currently known from 11 states and 49 counties, occurring most frequently in North Carolina, Tennessee, and Arkansas. It is currently a candidate (C2) for federal listing. Five populations of this taxon were surveyed in Hardin County, Illinois, during summer 1998. A total of 1,815 plants were censused in June. These plants ranged in height from 24.6-48.7 cm and number of stems from 2.0-16.0. A total of 984 plants were censused in flower in September, ranging in height from 57.5-72.6 cm, number of stems from 1.7-4.3, and number of flowers from 10.0-26.4 per stem. The largest population, which had 85.9% and 86.1% of all plants and flowering individuals, had 430 plants with capsules with an average of 13.7 capsules per plant. Soil pH at all sites averaged 6.0, soil depth 5.4 cm, 70.1% canopy cover, and 33.9% slope. Plants were found in soil pockets on sandstone cliffs and slideblocks and in rocky talus slopes in dry-, dry-mesic, and mesic-upland forest. Due to the small number of plants at the five sites in Hardin County, *S. ovata* has been proposed to be listed in Illinois as state endangered. This project was partially funded by the Illinois Department of Natural Resources, Natural Heritage Division from contributions to the Illinois Wildlife Preservation Fund.

- 163 KARTESZ, JOHN T. and ROBERT B. COXE Biota of North America Program CP#3280 Coker Hall, UNC-Chapel Hill, Chapel Hill, NC 27599 - A Visual Polyclave Computer Key for the North American Flora.

An alternative identification system to dichotomous keys is being developed by the Biota of North America Program of the North Carolina Botanical Garden for the entire vascular flora of North America north of Mexico. The system, here referred to as a visual polyclave, is a computerized identification key, using whole-plant illustrations and accompanying morphology to identify unknown taxa. Using a series of illustrations in concert with a relatively small number of morphological choices, a step-wise elimination quickly narrows the taxonomic possibilities. The identification process provides random access character-state selection, reducing the possibilities that remain via each choice. At any point in the selection process, the user may display a group of species images (representing those species not yet eliminated) and make a tentative identification by matching the unknown plant at hand with one of the images on the computer screen. The selected image could be enlarged, and a full morphological description of that species would also be available. In most cases, with only a few initial choices of geography and easily observable morphology, along with a selection from a display of images, an unequivocal identification can be made.

- 164 BRUBAKER, DANIEL A. AND JAMES J. WALLACE. Department of Biology, Western Carolina University, NC 28723- Flavonoid Identification within Hymenophyllaceae: *Macroglena*.

The phylogeny of the Hymenophyllaceae (filmy ferns) has been disputed for over a century. This group of 600-800 tropical to subtropical species has been reclassified several times with no agreement. Flavonoids have been utilized for studying numerous phylogenetic problems, especially within ferns and seed plants. This study represents a chemical approach for obtaining a better understanding relative to the phylogeny of *Macroglena*, a subgroup of *Trichomanes*, s.l. Chemical data will be utilized to interpret the phylogeny of two species, *M. brasii* and *M. caudata*, within the classical *Trichomanes* s.l. This research contributes to the ongoing project of the chemotaxonomy of Hymenophyllaceae.

- 165 HOWARD S. NEUFELD¹, E. HENRY LEE², JAMES R. RENFRO³, SONGQIAC HUANG⁴, AND W. DAVID HACKER⁵. ¹Dept. of Biology, Appalachian State University, Boone, NC, U.S. EPA, Corvallis, OR, Great Smoky Mountains National Park, Gatlinburg, TN, Dept. of Biology, Los Angeles Community College, Los Angeles, CA, and Dept. of Environmental Management, New Mexico Highlands University, Las Vegas, NM - Insensitivity of several conifer species to ozone in Great Smoky Mountains National Park

Evergreen species may be at great risk from ozone exposure because their leaves are kept on all year long, which means they have greater exposure than deciduous species. In Great Smoky Mountains National Park (GRSM), putative ozone injury has been observed in the field on needles of Table Mountain pine (*Pinus pungens*). We began an open-top chamber study of the effects of modified ambient ozone exposures on seedlings of four conifer species: *P. pungens*, Virginia pine (*P. virginiana*), pitch pine (*P. rigida*) and eastern hemlock (*Tsuga canadensis*). Table Mt. pine was exposed three years (1988-1990), as was eastern hemlock (1989-1991), whereas pitch pine was exposed only in 1989. Three different sets of V. pine were exposed; one for two years (1990-1991) and two for one year each (1990 and 1992). Treatments were charcoal-filtered, ambient, 1.0x, 2.0x in 1988, with 1.5x added in 1989, and 0.5x in 1990. No significant ($p < 0.05$) effects of ozone on biomass were found for any species, except for reductions in older needle biomass in the 1.5x and 2.0x treatments for Table Mt. and V. pines. Foliar effects were only noted in these same trts for just these two species. No effects were noted for hemlock. We conclude that current levels of ozone in GRSM are having minimal effects on these coniferous species, and that lack of fire (which inhibits reproduction of the pines) and the hemlock woolly adelgid, may be potentially more devastating in the short-term.

- 166 BASINGER, MARK A. AND PHILIP A. ROBERTSON. Southern Illinois University, Carbondale, IL 62901. Effect of beaver (*Castor canadensis*) on vegetation composition in a wet-floodplain forest at Horseshoe Lake Conservation Area, Alexander County, Illinois.

The effect of beaver on vegetation composition was studied in a wet-floodplain on Horseshoe Lake Island Nature Preserve. One-hundred 3 X 50 meter belt transects were established and sampled for woody and

herbaceous vegetation. An additional 23 permanent 0.04 ha plots which were sampled in 1973 were resampled. Cluster analysis of belt transect data was used to determine five tree and three herbaceous dominance types. Tree dominance types were *Acer rubrum*, *Diospyros virginiana*, *Fraxinus profunda*, *Liquidambar styraciflua*, and *Populus heterophylla*, while herbaceous dominance types included *Bidens discoidaelfrondosa*, *Lemna minor*, and *Polygonum punctatum*. Electivity indices of beaver woody plant preference showed significant avoidance of *Cephalanthus occidentalis* and significant preference of *L. styraciflua*, *F. profunda*, and *P. heterophylla*. Comparison of the 23 0.04 ha plots showed a decrease in basal area and density from 30.9 m²/ha and 400.3 stems/ha in 1973 to 22.6 m²/ha and 264.2 stems/ha in 1996. *C. occidentalis* increased in the shrub and seedling layer from 76.1 stems/ha and 1,130.4 stems/ha in 1973 to 239.1 stems/ha and 85,141.3 stems/ha in 1996. Buttonbush is the primary component in this wet-floodplain which has quickly become a shrub swamp. This project was partially funded by the USDA Forest Service, North Central Experiment Station, Columbia, Missouri.

- 167 RENTCH, JAMES S.¹, HAROLD S. ADAMS², ROBERT B. COXE³, AND STEVEN L. STEPHENSON.⁴ ¹Div. of Forestry, West Virginia Univ., Morgantown, WV 26506, ²Div. of Arts and Sciences, Dabney S. Lancaster Community College, Clifton Forge, VA, 24422, ³Robert J. Goldstein & Associates, Inc., Raleigh, NC, 27616, ⁴Dept. of Biology, Fairmont State College, Fairmont, WV, 26554-An ecological study of a Carolina hemlock (*Tsuga caroliniana*) community in southwestern Virginia.

Carolina hemlock (*Tsuga caroliniana* Engelm.) is a southern Appalachian endemic found on dry, nutrient poor, and exposed slopes. Rarely abundant, it sometimes occurs in nearly pure stands. We sampled a Carolina hemlock community in the southern Blue Ridge near Roanoke, Virginia. Carolina hemlock was dominant in the tree, small tree, and sapling strata. Oaks (*Quercus* spp.) were present in the canopy but do not appear to be self-sustaining, and maples (*Acer* spp.) were limited to the understory. The absence of Carolina hemlock seedlings at this site, and gaps in the age-diameter distribution of stems ≥ 5 cm DBH suggest that although it is a shade tolerant species, recruitment may be episodic. Increment-core dating, and the appearance of black birch (*Betula lenta*) in the stand also suggest that the dominance of Carolina hemlock may be attributable to the elimination of American chestnut during the 1930's and 1940's. The growth rate of Carolina hemlock at this site was greater than those reported by Humphrey on more productive sites in North Carolina which tends to confirm Humphrey's findings that Carolina hemlock exhibits a stress-tolerant life history strategy.

- 168 McMULLEN, CONLEY K. Dept. of Biology, MSC 7801, James Madison University, Harrisonburg, VA 22807 -Reproductive biology of three Galapagos Islands angio-sperms with an emphasis on nocturnal pollination.

During the past several years, important advances have been made in determining the taxonomic composition of the flora and insect fauna of the Galapagos Islands. Studies of interactions between flowering plants and their insect neighbors, especially with regard to pollination, have been initiated as well. The common denominator of these latter studies is that they were conducted almost entirely during daylight hours. In arid environments, however, nocturnal activity of insects is often much greater than diurnal activity. Breeding studies, pollinator observations, and nectar studies were conducted on individuals of *Cordia lutea* Lam. (Boraginaceae), *Ipomoea habeliana* Oliv. (Convolvulaceae), and *Clerodendrum molle* HBK. (Verbenaceae) to test the hypothesis that the importance of nocturnal pollinators might be equal to or exceed that of diurnal pollinators. Results of the breeding studies are being analyzed to determine the relative importance of open-pollination, autogamy, self-pollination, cross-pollination, nocturnal pollination, and diurnal pollination. Preliminary data analysis suggests that *I. habeliana* and *C. lutea* benefit from nocturnal pollination. In both cases, moths are the primary pollen vectors. Results from the nectar studies are currently being analyzed.

- 169 PITILLO, J. DAN, LARISSA KNEBEL AND AARON COOPER. Department of Biology, Western Carolina University, Cullowhee, NC 28723. Eastern hemlock (*Tsuga canadensis*) old-growth communities of Cataloochee watershed, Great Smoky Mountains National Park.

The hemlock adelgid (*Adelges tsugae* Annand) is progressing south of Virginia into North Carolina. The Cataloochee watershed of the Great Smoky Mountains National Park contains the most significant old-growth stands of eastern hemlock remaining in the southern Appalachians. In 1998 a study of these stands was undertaken using the North Carolina Vegetation Study protocol to better assess the features of the various hemlock community types. Characterization of these communities include the overstory tree, understory shrub, topographic position, and soil features. From these data, predictive models of the changes that will take place if the adelgid eliminates the hemlocks from these forests will be discussed.

- 170 BROWN, C. MICHELLE, HOWARD S. NEUFELD AND RAY S. WILLIAMS. Department of Biology, Appalachian State University, Boone, NC - Herbivory patterns in *Rhododendron maximum*, a broadleaved evergreen shrub of the southern Appalachian mountains

Not much is known about herbivory on broadleaf evergreen shrubs. *Rhododendron maximum* is a common understory shrub in the southern Appalachians, and we have observed herbivore damage to its leaves. The goal of this study was to determine the identity of the herbivores, and to relate the pattern of leaf injury to changes in leaf anatomy and chemical content. Our study is being conducted in the Environmental Studies Area on campus and involves identifying potential herbivores, and analyzing for any differences in herbivory among bushes, location within bush (upper versus lower branches) and across leaf ages. Most damage appears to be caused by a caterpillar that eats at the edges of young leaves, and a larval leaf miner, both of which are unidentified at this time. Preliminary analyses of the amount of leaf area missing (LAM) show an average LAM ranging from 2-7%, with statistically significant differences among some bushes. We found no statistical differences in LAM between branches more than 1 meter in height, and those lower (3.5% vs 3.2%, respectively), nor were there any major differences due to leaf age ($p > 0.05$). The lack of a leaf age effect suggests that leaves are eaten mainly when they are young and succulent. Leaves are currently being analyzed for total phenolics and condensed tannins. Samples were taken at periodic intervals during the 1998 growing season to allow for elucidation of developmental trends. In addition, samples for specific leaf weight were taken simultaneously so that changes in herbivory could be related to leaf developmental properties. Bushes will be resampled again this year, and both spatial and temporal trends in herbivory followed. These preliminary analyses suggest that herbivory has only minor effects on growth in this evergreen shrub.

- 171 MCKERROW, ALEXA J AND STEVEN G. WILLIAMS. NC Gap Analysis Project, North Carolina State University, Raleigh, NC 27695-7106 - An Overview of the North Carolina Gap Analysis Project

The North Carolina Gap Analysis Project is the state-based affiliate of the National Gap Analysis Program. The mission of the Gap Analysis Program is to "conduct regional assessments of the conservation status of native vertebrate species and natural land cover types and to facilitate the application of this information to land management activities." In order to complete a Gap analysis, three primary GIS datasets must be developed; land cover, predicted distributions of species, and land management status. In North Carolina, we are currently focusing on the vegetation portion of the land cover map and initiating the review process for the species range and habitat association data. Afterwards, we will develop models used to predict species distribution and assemble the land management status map. Conservation priorities can then be developed looking at the spatial array of both floral and faunal biodiversity. The completed datasets and analyses will be made available through the National Gap Analysis Program for use by anyone interested in conducting additional analyses.

- 172 KRUCZYNSKI, WILLIAM L., U.S. Environmental Protection Agency, Florida Keys National Marine Sanctuary, P.O. Box 500368, Marathon, Florida 33050 Plant communities at the land/sea interface: Why do we need to protect them?

Coastal wetlands are transitional zones between terrestrial and aquatic environments and are dominated by hydrophytic vegetation, plants adapted for life in saturated soil conditions. Coastal wetlands are generally dominated by few plant species present in great abundance. Species dominance is controlled by a combination of salinity, temperature range, and elevation. Salt marshes along the Atlantic and Gulf coasts are usually dominated by one or more species of *Spartina* at higher salinities and low elevations and by *Juncus roemerianus* at lower salinities and higher elevations. Mangrove wetlands generally replace salt marshes in tropical and subtropical areas. Coastal wetlands perform many valuable ecological functions including habitat, food chain productivity, water quality enhancement, and erosion protection. Estimates vary, but as many as 95% of commercial fish and 85% of sport fishes landed spent a portion of their life in coastal wetlands. Estimated values of coastal wetlands have ranged from about \$1000 to \$82,000 per

acre. Serious deterioration and losses of coastal wetlands are evident in many locations and most impacts are directly linked to increased human activities. Detrimental human impacts include draining, impounding, dredging, filling, and discharges of sediments and other wastes from point and non point sources. Population increases are greatest in coastal regions which has resulted in increased pressure for development in all coastal habitats. Subsidence due to oil and gas extraction and depriving wetlands from required sediment subsidies have led to alarming wetland losses of approximately 30 mi² per year in coastal Louisiana. In addition, storm surges and rising sea level can accelerate loss of wetlands. There has been a gradual recognition of the value of wetlands due in part to an increased understanding of their role in ecological processes and their tangible value to society. Historically, federal and state regulations have proven ineffectual at eliminating losses of coastal wetlands. "No-loss" policies and advances in creation and restoration technologies offer promise in maintaining and restoring the ecological integrity of coastal habitats.

173 DURAKO, MICHAEL J., The University of North Carolina at Wilmington, Department of Biological Sciences and Center for Marine Science Research, Wilmington, NC 28403. Changes in seagrass distribution and diversity: Is this a good thing?

Seagrass beds are conspicuous and often dominant components of the low-energy coastal seascapes of the S. E. United States. Consequently, they play an important role in many physical, chemical, geological, as well as ecological processes. Seven species of seagrasses occur in the region, thus species diversity within most seagrass beds is generally low. Seagrass beds are frequently monotypic in stable environments and most beds in the region contain three or fewer species. Species distribution and dominance change in response to a wide variety of natural and human-induced perturbations, usually with an increase in diversity. *Thalassia testudinum* (Turtle grass), the dominant seagrass in this region, is considered the climax species and is characteristic of stable, marine high-light conditions. This species is frequently replaced by pioneer species such as *Syringodium filiforme* (Manatee grass) or siphonaceous green algae in high-energy physical disturbances known as blowouts. However, following physical perturbations such as dredge and fill operations or propeller scarring, *Thalassia* may be replaced by *Halodule wrightii* (Shoal grass). Disturbances that cause a reduction in light available to seagrasses may result in an increase in seagrass species diversity as a result of recruitment and spread of low-light adapted species into a previously monotypic *Thalassia* bed. Once *Thalassia* is displaced, the benthic seascape may become more susceptible to additional changes in species distribution and abundance.

174 VARGO, GABRIEL A., Department of Marine Science, University of South Florida, 140 Seventh Ave South, St. Petersburg, FL. 33701. Coastal phytoplankton blooms: What are they telling us?

Coastal eutrophication has been well documented for most areas of the world, including the Southeastern U.S. Phytoplankton blooms, a significant ecological consequence of coastal eutrophication, have been hypothesized to result from causes as diverse as anthropogenic inputs of limiting nutrients to the disruption of normal biological controls. The implication of the title for this paper is that human activities are responsible for the disruption of these controls and consequently are responsible for coastal phytoplankton blooms. Smayda (1997), however, raises the question of what constitutes a phytoplankton bloom and argues that if that question can be answered then the cause-effect relationships may be discernable. If a bloom is defined as "a population of cells of a given species above background levels," such widely varying factors as the anthropogenic flux of both inorganic and organic limiting nutrients (e.g. as occurs in several North Carolina rivers and coastal waters), the role of physical concentration of phytoplankton populations (e.g. as is hypothesized for red-tide blooms on the West Florida shelf and in Alabama/Mississippi coastal waters), and the potential disruption of a primary trophic level (seagrass declines) with subsequent nutrient release (e.g. as hypothesized for the long-term cyanobacterial bloom in Florida Bay), can all be regarded as causative factors that have led to elevated levels of phytoplankton biomass in coastal waters. This paper will: 1. summarize the occurrence of coastal phytoplankton blooms in the southeastern U.S., 2. discuss the underlying factors responsible for bloom inception, maintenance, and nutrient-biomass relationships, and 3. put them into the context of their relevance to human activity in the coastal zone.

175 OGDEN, JOHN C., Florida Institute of Oceanography, University of South Florida, St. Petersburg, FL 33701. Coral reef conservation: What are the global and regional issues?

The growing concern with human disturbance of the world's coral reefs encompasses the scope of the emerging field of marine conservation biology. While marine scientists have concentrated on the differences between the terrestrial and marine realms, there are many similarities. For example, the development of agriculture required the extirpation of large terrestrial predators with consequent cascading ecosystem disturbances, particularly the destabilization of herbivore populations. On coral reefs, we are presently learning this same lesson through over-fishing of large

predators which results in similar disturbances in lower tropic levels. The "no take" marine reserve is another case in point. Where even tiny marine reserves have been protected from human disturbance, particularly fishing, the uniform result has been that the reserve will have more and bigger fishes within a few years. This is a familiar experience in terrestrial parks and reserves. Finally, the future health of coral reefs is dependent upon the development of sound land-use and materials disposal practices by coastal human societies. The major difference between conservation on land and sea is that the geographic scale of marine conservation is large--that of whole eco-regions. Using the greater Caribbean Sea as an example, the scientific rationale underlying the eco-region concept will be examined along with the policy considerations for the implementation of an international network of marine reserves. The case will be made that it is time to re-invent the Regional Seas Program of the original 1972 UN Conference on the Environment in the light of science and policy advances in the past 25 years and the growing global concern that, in the words of Carl Safina, "The ocean is in trouble and therefore so are we "

176

GEORGE, ROBERT Y., The University of North Carolina at Wilmington, Department of Biological Sciences and Center for Marine Science Research, Wilmington, NC 28403 Biological Impact of the Gulf Stream on coastal marine ecosystems: Are there seasonal and climatological signatures?

The coastal marine communities of the southeastern United States, from Florida to North Carolina are profoundly influenced by the core rings, meanders, and eddies of the Gulf Stream, with particular biological impact from episodic upwellings, which result in increased productivity and recruitment on the continental shelf. This paper examines conceptually the biological influence of the Gulf Stream, with emphasis on seasonal and possible recent climatological pulses that are induced by global warming and hurricanes. The following aspects will be discussed: (1) Formation of fingers and core rings off the Carolinas, north of the Charleston Bump; (2) Fish and crustacean, such as the spiny lobster, recruitment processes in the temperate reefs in Onslow Bay; (3) American eel migration west and east of the Gulf Stream; (4) Tuna and turtle migration aided by the Gulf Stream; (5) Zooplankton, nekton and oceanic bird abundance in the Gulf Stream fronts; and (6) evidence of recent changes in the course of the Gulf Stream as a consequence of global warming.

177 POSS, STUART G., Gulf Coast Research Laboratory Museum, Institute of Marine Sciences, University of Southern Mississippi, P O Box 7000, Ocean Springs, MS 39566-7000 Coastal fish distribution and diversity in the Southeastern United States: How is it changing?

Fishes whose biology is closely tied to coastal ecosystems comprise the largest component of the fish fauna of the Southeastern United States. Coastal fish faunas are experiencing dramatic changes resulting from increases in human populations. Many coastal fish species are directly targeted for human consumption, either as food or animal products, or for recreation. Over-fishing is a serious problem for elasmobranchs and certain bony fishes with limited reproductive capacities. Many other species are impacted primarily through habitat loss or degradation resulting from a variety of causes, which include disruption through dredging, filling, and channelization, pollution from toxics, nutrients, and sediments, and introductions of non-indigenous species. Different taxa and geographic regions are differentially affected. Species with limited distributions, those associated with seagrasses, or those having anadromous life cycles are particularly at risk. Although limited data exist, estimates based on patterns of historical collecting strongly suggest that a significant fraction of coastal ichthyofaunal diversity will be lost to extinction and local extirpation in the next 50-100 years.

178 Webster, Wm. David, Department of Biological Sciences, University of North Carolina at Wilmington, Wilmington, NC, 28403-3297 - *Sea Turtle Distribution and Breeding along the Southeastern United States Coast: Can We Maintain the Populations?*

The southeastern coast of the United States is one of the world's primary breeding grounds for several species of marine turtles, all of which are afforded protection under the Endangered Species Act (ESA) and the Convention for International Trade in Endangered Species of Flora and Fauna (CITES). Marine turtles have low rates of reproductive success (<1% reach sexual maturity) due to predation and the small- to large-scale catastrophic effects of beach erosion and inundation. Furthermore, marine turtles are threatened by loss or degradation of nesting habitat, poaching of nesting females and their eggs, drowning in seines and nets, ingestion of foreign objects, degradation of the ocean environment, and the inadequacy of existing regulatory mechanisms in other parts of each species' range. Nonetheless, there is good news. The plight of sea turtles has been well

publicized and local awareness has increased dramatically in the last 30 years. Kemp's ridley, the rarest of all sea turtles, has benefitted from a cooperative recovery effort between Mexican and United States regulatory agencies. Optimism must be tempered, however, by the fact that human population growth will exacerbate many of the prominent threats to the survival of this important component of marine ecosystems.

- 179 HODSON, RONALD G., North Carolina Sea Grant College Program, Box 8605, North Carolina State University, Raleigh, NC 27695-9605. *Potential for aquiculture in coast: A North Carolina Example.*

Worldwide consumer demand for wholesome seafood continues to increase- global seafood demand is expected to increase 70 percent by the year 2025. Aquiculture has the potential to meet much of this increasing demand. And, the potential for aquiculture development in North Carolina is enormous because it has excellent natural and human resources. Thousands of acres of coastal farmland have an underlying clay base, ideal for construction of aquiculture ponds and water is available from several aquifers capable of supplying either freshwater or brackish water. Abundant sources of brackish surface water are also available from North Carolina's estuaries and coastal ocean to support mariculture of shellfish and finfish. Much of the infrastructure to support aquiculture, such as transportation, feed mills and seafood processors is already established. North Carolina's human resources are also poised to support coastal aquiculture. In North Carolina, Sea Grant, the university systems and the community college systems provide the intellectual resources that support aquiculture research and extension programs. Resources based industries are readily accepted in coastal North Carolina because the people have a history of making a living from the land and water. Finally, a simple permitting process has been established for land based operations and this model is in the process being adapted for saltwater aquiculture.

- 180 BARNETT, KIRK G., MICHAEL L. LITTLE, AND DONALD C. TARTER. Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - Preliminary observations on the isozyme patterns and morphometrics of *Gambusia* sp. in the Green Bottom Wildlife Management Area, West Virginia.

Prior to 1988, two subspecies of the mosquitofish *Gambusia affinis* (*G. a. affinis* and *G. a. holbrooki*) were recognized in the warm southern waters along the Gulf and Atlantic coasts of the United States. Based upon electrophoretic and morphometric analysis in 1988, *G. holbrooki* and *G. affinis* were determined to be distinct taxa. Populations west of Mobile Bay, Alabama, were established to be *G. affinis* and those east of Mobile Bay to be *G. holbrooki*. Only two populations of mosquitofish have been found in West Virginia: the Meadow River wetlands, Greenbrier County and the Green Bottom Wildlife Management Area, Cabell and Mason counties. Isometric focusing of glycerol-3-phosphate dehydrogenase isozyme patterns from heart, muscle, liver, and brain tissues, as well as ten morphometric characteristics were used to determine that the Green Bottom populations of mosquitofish were *G. affinis*.

- 181 WYKLE, JENNIFER AND DONALD C. TARTER. Dept. Biological Sciences, Marshall University, Huntington, WV 25755.- Range extensions and low pH tolerances of the amphipods *Crangonyx rivularis* and *C. richmondensis richmondensis* from the Meadow River wetland complex, West Virginia.

The amphipods *Crangonyx rivularis* and *C. richmondensis richmondensis* are recorded for the first time from West Virginia. The record for *C. rivularis* represents a significant southern extension of the known range which was previously limited to Ontario, Canada. The record for *C. richmondensis richmondensis* extends the western range of the subspecies which was previously known from Nova Scotia, Main, Massachusetts, New Hampshire, South Carolina and Georgia. Acidification can have impacts on amphipod populations. Low pH can alter acid-base balance, respiration, and sodium and calcium regulation. Using a standard D-shaped dredge, one-hundred amphipods of both species were collected from the Meadow River wetland complex. Amphipods were returned to the laboratory and allowed to acclimate in a controlled environmental chamber for 24 hours. Ten amphipods were placed in each of five duplicate bowls. They were exposed to the following pH values: 1.5, 3.0, 4.5, 6.0, and 7.0 (control). After the 96-hour experiment, the median tolerance limit (TLM) was calculated using the straight-line graphical method and linear regression analysis. The 96-hour TLM pH value was 3.8. Results were compared with other laboratory and field studies concerning pH tolerance values on amphipods.

- 182 WOOTEN, MATTHEW S.¹, ERICH B. EMERY² AND DONALD C. TARTER¹. ¹Dept. Biological Sciences, Marshall University, Huntington, WV 25755 and ²Ohio River Valley Water Sanitation Commission, Cincinnati, OH 45228 - Selection of reference sites and testing of candidate metrics for a macroinvertebrate index on the Ohio River.

Macroinvertebrate indices have long been used as water quality indicators in small streams, but due to the constraints of working with large rivers, such as the Ohio River, an index has yet to be developed. Due to the diversity of large river systems, biological indices for small streams may not be applicable. The Ohio River begins in Pittsburgh, Pennsylvania at the confluence of the Monongahela and Allegheny Rivers and flows 981 miles in a southwesterly direction where it empties into the Mississippi River at Cairo, Illinois. Macroinvertebrate samples were taken using Hester-Dendy multiplate artificial substrates. A sampler was placed every five miles for the entire length of the river and collected after a six-week colonization period. All samples were sorted and identified to the lowest taxonomic level possible. Reference locations were selected based on the distance below effluent discharges. Statistical analysis including correlation graphs and box and whisker plots were used to determine the most descriptive metrics and best location of reference sites. Preliminary results indicated that samplers located 1 mile or more below an outfall display only slight differences among the tested metrics.

- 183 ROSE, TARA L.¹, ERICH B. EMERY², AND DONALD C. TARTER¹. ¹ Dept. Biological Sciences, Marshall University, Huntington, WV 25755 and ²Ohio River Valley Water Sanitation Commission, Cincinnati, OH 45228, - Distribution of the sucker family (Pisces: Catostomidae) in the Ohio River.

The sucker family (Pisces: Catostomidae) represents a major component of the fish fauna of the Ohio River. Because of their considerable abundance, large biomass, and susceptibility to environmentally-induced anomalies, the 15 species of suckers found in the Ohio River will profoundly influence several of the metric components proposed for inclusion in the Ohio River Fish Index (ORFI) by the Ohio River Valley Water Sanitation Commission. To better understand the impact of the sucker family upon the index, electrofishing data collected from 1991 to 1998 were used to determine river wide distribution patterns for 14 sucker species. Most species were found in greatest numbers in the upper river; however, two species, the bigmouth buffalo (*Ictiobus cyprinellus*) and the river carpsucker (*Carpionodes carpio*), were captured more frequently in the lower river. Breeding habitat availability, stomach content, and microhabitat were also analyzed in order to identify the origins of these distribution patterns. Spatial distribution within navigational pools was determined for each species. An examination of temporal distribution data obtained from rotenone lock chamber surveys and dating from 1957 showed a decrease in pollution tolerant sucker species, particularly the white sucker (*Catostomus commersonii*), with a concurrent increase in pollution intolerant species.

- 184 ADERMAN, JENNIFER AND DONALD C. TARTER. Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - Life history and ecology of the freshwater prawn, *Palaemonetes kadiakensis*, in a mitigated wetland of the Green Bottom Wildlife Area, West Virginia.

An ecological life history of the freshwater prawn *Palaemonetes kadiakensis* was conducted at the mitigated wetland of the Green Bottom Wildlife Management Area (GBWMA), West Virginia. Monthly samples were collected from November 1996 through November 1997. Additionally, weekly samples were collected from May through November for growth and reproductive analysis. Monthly samples yielded 520 prawns. *Palaemonetes kadiakensis* in GBWMA had a one-year life cycle, with all adults dying by September. Males averaged 23.8 mm (range=14.2-36.8 mm) and females averaged 26.8 mm (range=15.1-38.6 mm) in length. Males averaged 0.09 g (range=0.02-0.29 g) and females averaged 0.14 g (range=0.02-0.24 g). There was a significant correlation ($r=0.915$) between average length and weight. For the monthly collections, the largest percent growth occurred between August and September (32.6%) with an average temperature of 21.7 C. For the weekly collections, the largest percent growth occurred between 31 July and 07 August (39.3%) with an average temperature of 26.5 C. There was no significant difference in sex ratio ($p=0.45$). Ovigerous females were present from 30 April to 12 August, carrying an average of 60 eggs. There was a low correlation ($r=0.42$) between fecundity and length of female. Plant detritus was the main food item for all four seasons, ranging from 82.2 to 97.9 percent, winter and spring, respectively.

- 185 MORGAN, JASON A.¹, JANET L. CLAYTON², AND DONALD C. TARTER¹. ¹Dept. Biological Sciences, Marshall University, Huntington, WV 25755 and ²West Virginia Division of Natural Resources, Elkins, WV 26241. - Food habits of *Salmo trutta* and *Salvelinus fontinalis* (Pisces: Salmonidae) in relation to age, season, and mitigative liming effects in Dogway Fork, West Virginia.

Dogway Fork, a tributary of the Cranberry River in West Virginia, is acidic due to poorly buffered soils and acid precipitation. This study is part of a long-term investigation involving the effects of continuous limestone neutralization of the fishes and benthos of an acid stream. Prior to treatment (pH=4.5), no reproducing fish populations were collected in Dogway Fork. Following treatment (pH=6.0), nine species have been collected and six species have reproduced following the improvement in water quality. Densities of specific acid - sensitive benthic macroinvertebrates have increased following treatment. For the food habit study, trout were collected seasonally by electrofishing and stomach contents were removed by flushing using a bulb pipette. Benthic samples were collected in duplicates using a modified Surber Sampler. Comparisons were made between diets of brook and brown trout populations in the mitigated liming area.

- 186 LOWMAN, BEN M.¹, ERICH B. EMERY², DONALD C. TARTER¹. ¹Dept. Biological Sciences, Marshall University, Huntington, WV 25755 and ²Ohio River Valley Water Sanitation Commission, Cincinnati, OH 45228. - Changes among Ohio River fish populations due to ecological and reproductive conditions created by high-lift dams.

Since 1957, biological data has been collected from the Ohio River by the Ohio River Valley Water Sanitation Commission (ORSANCO). Included in this data is an extensive monitoring of fish populations, which reflect many changes in the abundance of certain species. These population peaks may be associated with the construction of many high-lift dams along the entire reach of the Ohio River. Fish collections obtained through the use of rotenone, an ichthyocide, applied to navigational lock chambers and electrofishing verify that great differences in abundance exist between species found in waters raised by high-lift dams and those found in waters left shallow. Preliminary data analysis indicated that more than 25 species displayed a distinct increase in abundance or population peak during the period of dam construction. These increases may be associated with ecological and reproductive changes resulting from the vegetative habitat created by dam-expanded waters.

- 187 TOMASEK, TERRY AND DONALD TARTER. Dept. Biological Sciences, Marshall University, Huntington, WV 25755 - Preliminary results on the long-term impacts of multiple seam contour mining and valley fill on water quality and benthic macroinvertebrates in a West Virginia stream.

Seam surface coal mining removes entire mountain peaks or sides. Excess rock and dirt is layered into nearby valleys thereby creating a post-mining terrain that is flat or gently rolling. Since the headwaters of many streams are located in these valleys, water quality is a central focus of the current debate in regards to this type of mining. Using rapid bioassessment protocols, this study compared historical (1987) benthic macroinvertebrate and water quality data with current (1998) data on five stations in an unnamed tributary in West Virginia. This tributary was impacted by overburden from multiple seam contour mining activities. After approximately four years, mining operations ceased and reclamation plans proceeded on the existing valley fill. Presently, water quality and erosion/sediment controls meet WVDEP standards. The following metrics improved after mining and reclamation activities: EPT (5 to 18), taxa richness (12 to 35), taxonomic orders (7 to 11), and species diversity (1.28 to 1.88). The average percent similarity between the historical sites (5) and current sites (5) was only 27.6. These preliminary results show that the benthic macroinvertebrates and water quality responded favorably after 11 years.

- 188 GINGER, JEFFREY V.¹, DONALD C. TARTER¹, BRET A. PRESTON², AND ERICH B. EMERY³. ¹Dept. Biological Sciences, Marshall University, Huntington, WV 25755; ²West Virginia Division of Natural Resources, Charleston, WV, and ³Ohio River Valley Water Sanitation Commission, Cincinnati, OH 45228. - The relationship between Ohio River bass tournament success rates, forage fish abundance, and environmental conditions.

Following low catch rates by Ohio River bass tournament anglers in 1981, 1990, and 1997, the West Virginia Division of Natural Resources (DNR) initiated a study to correlate annual variations in bass tournament success with annual river flows and forage abundance. The Ohio River Valley Water Sanitation Commission (ORSANCO), in conjunction with state and federal agencies, has collected Ohio River fish population data at lockchambers, and has measured various water quality parameters since 1957. This information coupled with Ohio River bass tournament data that the DNR has collected since 1975, and other fishery data sets, will provide a historic look into the variability of angler success. These data sets also will be used to characterize annual trends in the abundance of forage fish like gizzard shad and emerald shiners, and assess their relationship to the environmental data. Historic angler success will then be compared to these data sets and statistically analyzed. It is suspected that cyclic patterns in forage fish abundance and weather events may affect angler success rates. The last part of the study is a characterization of the usefulness of lockchamber rotenone surveys in their ability to assess Ohio River fish populations.

- 189 THOMPSON, ALTHEA AND SAFAA AL-HAMDANI. Department of Biology, Jacksonville State University, Jacksonville, AL 36265. Salinity Influence on Selected Physiological Responses in *Salvinia minima*.

Salvinia were grown for seven days under controlled environment at different NaCl concentrations (0.0, 2.5, 3.0, 3.5, 4.0 g/l). Sodium chloride was shown to reduce photosynthetic rate in decreasing order as the salt concentration increased. This reduction in CO₂ assimilation coincided with the reduction in plant growth. However, chlorophyll and carotenoid concentrations were increased with the increase in salt concentration up to 3.0g/l. Anthocyanin concentration in *Salvinia* was also increased with the increase in salt concentration. In addition, *Salvinia* was shown to increase Na uptake with the increase in Na concentration in the growth medium.

- 190 BONE, SAMANTHA AND SAFAA AL-HAMDANI. Department of Biology, Jacksonville State University, Jacksonville, AL 36265. Independent Influence of Light and Temperature on *Salvinia minima* Growth, CO₂ Assimilation, and Photosynthetic Pigments.

Independent influence of different temperature, (23, 35, 15°C) and light intensities of 200-600 $\mu\text{E m}^{-2}\text{s}^{-1}$ on *Salvinia minima* were evaluated. The plants were grown in separate growth chambers for 14 days under the treatments of each experiment. The highest growth rate was obtained at temperature of 23°C followed in decreasing order by 35 and 15°C. Photosynthetic pigment concentrations in *Salvinia* increased as the temperature increased from 23-35°C. However, chilling temperature was shown to reduce the chlorophyll and carotenoid concentration but increase the anthocyanin. Soluble sugar accumulation was highest in *Salvinia* at 15°C followed in decreasing order by 23 and 35°C. Light intensities between 200 and 500 $\mu\text{E m}^{-2}\text{s}^{-1}$ had a similar effect on *Salvinia* growth. However, increasing the light intensity above 600 $\mu\text{E m}^{-2}\text{s}^{-1}$ resulted in decrease in plant growth. A similar effect was obtained for photosynthetic pigment, with the highest chlorophyll and carotenoid concentration at 260 $\mu\text{E m}^{-2}\text{s}^{-1}$. Photosynthetic rate was decreased as light intensity increased above 250 $\mu\text{E m}^{-2}\text{s}^{-1}$.

191

- WINSTEAD, JOE E. Dept. Biological and Environmental Sciences, Morehead State University, Morehead, KY 40351 - Growth rate and reproductive patterns in *Polygonum cuspidatum*.

An Asiatic member of the Buckwheat family, *Polygonum cuspidatum* or Japanese Knotweed (Mexican Bamboo), introduced and widespread in the United States shows aggressive colonization in streams, stream banks, moist disturbed areas and even curb habitats in Rowan County, Kentucky. Individual plants commonly reach heights of 200 cm with growth rates of 2 cm/day until flowering. Dry weight increases of 207% or 1.44 gm/day per plant were recorded over a 30 day period in an intermittent stream population with a relatively low shoot/leaf ratio of 1.15. Experimental shoot cuttings indicated a 70% successful adventitious root development within 14 days of stems harvested prior to floral bud development compared to a 20% rooting potential in shoots developing flowers and indicates a means of rapid colonization in aquatic habitats.

- 192 HELMS, BRIAN S. and ROBERT P. CREED, JR. Appalachian State University – The effects of coexisting crayfish on sediment accumulation in an Appalachian river.

Crayfish have recently been shown to be ecosystem engineers in some streams and one of their major impacts is to reduce sediment abundance on substrates. Two crayfish species, *Orcouectes cristavarius* (Oc) and *Cambarus chasmodactylus* (Cc), coexist in the South Fork of the New River in western North Carolina. The influence of these two crayfishes on sediment accumulation was investigated using an enclosure-exclosure experiment. Five rows of hardware-cloth cages (0.25 m²) with an enclosed basket (90 cm²) were placed on cobble/gravel substrate in a relatively uniform section of the river with a mean current velocity of 15 cm/s. Each row consisted of five treatments (Oc enclosure, Cc enclosure, crayfish exclosure, cage control, open basket). Both the cage control and open basket were exposed to fish, including the benthic-feeding central stoneroller (*Camptostoma auomulum*) and northern hogsucker (*Hypentelium nigricans*). There was a significant treatment effect on sediment accumulation. Very little sediment was found on the substrata in both the open baskets and cage controls; 2-3X more sediment was found on substrata in both the Oc and Cc enclosures. The most sediment (6-7X more than in open baskets and controls) was found on substrata in the enclosures. These results suggest that 1) these coexisting crayfish do not differ in their effects on sediment accrual and 2) these crayfish are not the only organisms that affect sediment accrual in this river. Both crayfish and benthic-feeding fishes appear to be important ecosystem engineers in this part of the New River.

- 193 MARTIN SHANNON B., RONALD SICARD, AND GARY P. SHAFFER. Dept. of Biological Sciences, Southeastern Louisiana University, Hammond, LA 70402 - A greenhouse study to determine the effects of saltwater intrusion, flood regime, and substrate type on three species of Sagittaria.

In the Lake Pontchartrain Basin arrowhead (*Sagittaria latifolia*) and duck potato (*Sagittaria platyphylla*) have decreased in abundance or disappeared while bulltongue (*Sagittaria lancifolia*) has greatly expanded its distribution. Several factors may be important in these distributional patterns, including saltwater intrusion, changes in substrate type, or altered flood regimes. The purpose of this study was to simultaneously manipulate these factors under controlled greenhouse conditions. The study consisted of a competition experiment that included three salinities, two levels of flooding, and two substrate types with two replicates. Aboveground dead biomass was harvested, oven dried, and weighed. Aboveground dead biomass production was used as a measure of leaf turnover and growth potential at a given time period. In this study, all three species began with relatively high turnover across salinities and arrowhead greatly increased during the later weeks in the freshwater treatments and will presumably out-compete the other two species, at least in the 5 cm flooding regime. While arrowhead and duck potato are dominating bulltongue in the freshwater treatments, the reverse trend is evident at the 3 and 6 ppt salinities. Bulltongue was surprisingly salt tolerant, displaying steady growth in even the 6 ppt salinity. This result suggests that bulltongue may actually be facilitated by low salinity regimes as arrowhead and duck potato become less competitive and that the pattern of replacement of arrowhead and duck potato by bulltongue in the upper Lake Pontchartrain Basin may be a result of salt water intrusion.

- 194 DESROCHES, DENNIS J., GARY P. SHAFFER, AND MARK W. HESTER. Southeastern Louisiana University - Restored drill cuttings: A mesocosm approach to determine the suitability as a substrate for wetlands restoration and creation.

It is well documented that Louisiana has the highest rate of wetland loss in the United States. Many subsiding areas are isolated from riverine sediment sources, therefore alternative methods for sediment deposition must be utilized. This project demonstrates that the earthen materials produced when drilling for oil and gas may be processed to reduce toxicity and used as a substrate for growing wetland plants. Two different restored drill cuttings, Substrates A and B, were compared to a topsoil control and to dredge spoil. Three hydrologic regimes (moist, flooded, and tidal) were imposed across all substrate types. Five plant treatments were applied during the first year and additional plant species were assessed during the second year of the study. Substrate toxicity and redox potential were measured. Interstitial water samples were analyzed to determine pH, and elemental and nutrient content. Both Substrates A and B demonstrated low toxicity. Substrate B had a high pH, was the most reduced substrate, and contained high levels of aluminum. Plant photosynthetic responses and biomass partitioning elucidated plant species preferences for substrate type and hydrologic regime. Substrate A performed comparably to dredge spoil for most variables. Substrate B supported minimal plant growth. *Colocasia esculenta*, *Sagittaria lancifolia*, *Typha latifolia*, and *Spartina patens* emerged as potential plant species for wetland creation on Substrate A, a restored drill cuttings product.

- 195 SOUTHER, REBECCA F., GARY P. SHAFFER, AND FRANK CAMPO. Dept. of Biological Science, Southeastern Louisiana University, Hammond, LA 70402- The effects of variable levels of submergence and light on two age classes of baldcypress (*Taxodium distichum* (L.) Richard) seedlings.

In a greenhouse experiment, two hundred baldcypress seedlings were planted in a four-way factorial arrangement that included five light transmissions, five flood durations, nutrient augmentation, and two age classes. Redox potential and height increase were used as dependent variables. Highly significant differences in height were found for the two main effects age and flood duration. Overall, the one-year olds were more stress tolerant and increased in height more than the young-of-the-year. The seedlings of both age classes increased significantly more in height in the treatment that was not flooded than in the treatments that were flooded. A significant three-way interaction was observed between light transmission, flood duration, and age. As light increased, the survivorship and growth of the young-of-the-year seedlings diminished in the 35- and 45-day flood treatments. As the flood period increased, the young-of-the-year showed greater signs of suppressed growth. All of the young of the year seedlings experienced 100% mortality at 35 and 45 days flooding combined with full sunlight while the one-year old trees remained largely unaffected across light regimes. An extension of the previously described study provided evidence that 1-year old seedlings may be able to survive 4 months of complete submergence.

- 196 SANDHU, RAVINDER AND BRENDA BOBO. Troy State University, Troy, AL 36082 - Effects of ambient ultraviolet radiation (UV-A and UV-B) on growth of cucumber plants.

Effects of ambient UV radiation were observed on growth of cucumber plants (*Cucumis sativus* L.) cv. Marketmore. Plants were grown in plastic pots and kept in wrap boxes for 14 days. Boxes were covered with three selective UV filters to comprise four treatments including an open plot. The treatments were: (i) no UV-B or UV-A (filter = 3 mil Lumar); (ii) no UV-B (filter = 5 mil Polyester); (iii) UV-B and UV-A (filter = 3 mil cellulose diacetate); (iv) UV-B and UV-A (open plot). Hypocotyl and petiole length, absolute and relative leaf area, biomass, and total chlorophyll were measured after two weeks. All growth parameters were significantly higher in plants where UV-B radiation was filtered out. Hypocotyl and petiole length showed a significant increase where plants were not exposed to ambient UV-B radiation. Similar increase were observed in other parameters in the treatments where UV-B was filtered out. Results suggest that ambient UV-B radiation has inhibitory effect on growth of Marketmore cucumber plants. This project was financially supported by NASA/JOVE program.

- 197 MARSHALL, JILLIAN A., OLIVER B. REID, AND LAWRENCE W. ZETTLER. Department of Biology, The Illinois College, Jacksonville, IL 62650 - A beneficial effect of low seed density on the development of *Encyclia tampensis* (Orchidaceae): First demonstration for an epiphytic orchid

We report a profound increase in the number of leaf-bearing seedlings of *Encyclia tampensis* (Lindley) Small obtained during *in vitro* symbiotic culture when seeds were sown at a low density. Seeds of *E. tampensis*, a commercially-exploited epiphytic orchid native to peninsular Florida and the Bahamas, were sown on a 1 x 2 cm filter paper strip on oat meal agar in a Petri dish in groups of different sizes: 200+, 75-150, 25-50, 1-10. Seeds were inoculated with a fungus (*Epulorhiza* sp.; UAMH 9203) isolated from a second epiphytic orchid, *Epidendrum conopseum* R. Brown, and incubated 70 days (22-24° C; LD 0:24 hrs). The percentage of leaf-bearing seedlings increased with decreasing seed density: 7% of seeds (group size 200+), 18% (75-150), 71% (25-50), 74% (1-10). A similar trend - though not as pronounced - was observed for older seeds (stored an additional 35 days) incubated at higher temperatures (24-28° C; LD 0:24 hrs). These results showing density-dependence on development of *E. tampensis* imply that conservation measures aimed at optimizing epiphytic orchid micropropagation will be enhanced by reducing the number of seeds sown per culture dish.

- 198 DERAIMO, DAVID, AMY BRITT, JAGAN V. VALLURI, AND H. WAYNE ELMORE. Dept. Biological Sciences, Marshall University, Huntington, WV 25755. -Protein synthesis and stress ethylene production in sandalwood callus cultures exposed to heat shock.

Environmental stresses such as drought and heat shock have been shown to elicit the production of specific proteins in plants. Heat shock in higher plants induces synthesis of a unique group of proteins, the heat shock proteins (HSP). A knowledge of the molecular responses such as gene expression during cellular adaptation would be helpful and might lead to the identification of the altered putative genes. Sandalwood callus was maintained on Murashige and Skoog medium supplemented with 1 mg/L 2,4-D and 1 mg/L benzyladenine. Rapidly growing sandal callus was exposed to elevated temperatures ranging from 32C to 45C. Protein synthesis induced by heat shock was assessed by SDS-polyacrylamide gel electrophoresis. After 48 h of exposure to stress, a 30% reduction in callus volume was observed. Silver staining and incorporation of radiolabel revealed a diverse array of low molecular weight proteins at 36, 40 and 45C after 6 to 8 hours of heat shock. Although most appeared to be synthesized only during heat shock, some were detectable at low levels in control tissue. Stress ethylene was analyzed by GC. At elevated temperatures ethylene production was greatly inhibited. However, recovery from heat shock is relatively rapid and is followed by stimulated ethylene production.

- 199 AL-HAMDANI, SAFAA H. AND NICHOLS, P. BRENT. Jacksonville State University – Spectral Characteristics and leaf gas exchange of *Kalmia latifolia*.

Transmission and reflection of the visible to near infrared light of *Kalmia latifolia* (Mountain Laurel) was evaluated from April 1998 through December 1998. The plant community sharing the habitat with *Kalmia latifolia* influenced both light transmission and reflectance. In addition, photosynthetic capacity was seasonally influenced by light wavelengths penetrating through the forest canopy. Photosynthesis appeared to be less influenced by chlorophyll accumulation through the season. Chlorophyll content was shown to be significantly different among the leaves developing throughout the season.

- 200 CONNELL, SHOUNDA AND SAFAA AL-HAMDANI. Department of Biology, Jacksonville State University, Jacksonville, AL 36265. Kudzu Response to Selected Concentrations of Sodium Chloride.

The influence of different NaCl concentrations (0.0, 25, 50 and 75 mmol) on Kudzu growth and gas exchange was evaluated. The plants were grown hydroponically in the greenhouse for 14 days under the salinity treatments. Kudzu growth was significantly reduced with the increase of NaCl concentrations. This decrease in plant growth coincided with a decrease in photosynthetic rate. However, stomata conductance was not effected by different sodium concentration. The increase in salinity resulted in an increase in chlorophyll a and chlorophyll b concentration. Osmotic potential was more negative at 75 mmol NaCl which influenced a more negative water potential value. Carbohydrates accumulation were increased with salinity stress.

- 201 TOLBERT, VIRGINIA¹, J.D. JOSLIN², B.R. BOCK², F.C. THORNTON², D.E. PETTRY³, W. BANDARANAYAKE⁴, S. SCHOENHOLTZ³, A. HOUSTON⁴, D. TYLER⁴, S.B. McLAUGHLIN¹
¹Oak Ridge National Laboratory, Oak Ridge, TN 37831, ²TVA, Muscle Shoals, AL, ³MS State U, Stoneville, MS, ⁴Univ. TN/Ames Plantation, Grand Junction, TN -Belowground carbon sequestration associated with conversion of agricultural lands to bioenergy crop cultivation.

Since 1994, studies at three locations in the Southeast have focused on the environmental effects of converting agricultural lands to production of herbaceous and short-rotation woody crops (SRWC). Differences in erosion, soil quality, and water quality from SRWCs, switchgrass, and agricultural crops have been quantified. Comparisons show that increases in carbon sequestration under these bioenergy crops have occurred primarily in the upper 15 cm of the soil profile. On sites converted from traditional corn production, soil carbon increased under sweetgum with a cover crop between rows, switchgrass, and no-till corn; sweetgum treatments without a cover crop showed a 6% decrease in soil carbon storage. The three woody crops sequestered considerable organic matter (OM) belowground as stumps, large roots, and woody fine roots. At the TN site, this coarse woody OM comprised 4.8 Mg ha⁻¹, of which 79% was stumps and large roots and 21% fine roots. Carbon sequestration under switchgrass trials occurred mainly in the upper 15 cm and continued to increase with time following establishment. These comparisons show that bioenergy crops can contribute to belowground carbon sequestration; however, the extent and timing is dependent on their individual growth characteristics.

- 202 LICKEY, EDGAR B., LAURA MCGHEE, AND KAREN W. HUGHES. Department of Botany, University of Tennessee, Knoxville, TN 37996 - Variability in the occurrence of a Group I intron in several species in the Auriscalpiaceae (Homobasidiomycetes).

Group I introns are mobile, self-excising insertional elements that have been found in viruses, eubacteria, and in nuclear and organellar genomes of a variety of eukaryotes. Recently, one such intron was found to occur in the nuclear small subunit (18S) ribosomal RNA gene of single isolates of *Panellus stypticus*, *Lentinellus ursinus*, *L. omphalodes*, and *Clavicornia pyxidata* (Hibbett, 1996). The intron was not observed in an isolate of *Auriscalpium vulgare*. This study was undertaken to further examine the distribution of Group I introns within and between the species of *Lentinellus*, *Auriscalpium*, and *Clavicornia*. We surveyed 92 isolates of seven species of *Lentinellus*, 15 isolates of 2 species of *Auriscalpium*, and approximately 300 isolates of 15 species of *Clavicornia*. The occurrence of the intron among the species of these genera is variable. Furthermore, variability in length and possible number of introns has been observed across populations of the pan-Northern Temperate species *Clavicornia pyxidata*. Heterozygote conditions have been observed in several cases.

- 203 McELROY, TOM C. AND DIEHL, WALTER J. Mississippi State University – Genotypes of multiple allozyme loci interact with an experimental environment to affect survivorship in earthworms (*Eisenia andrei*).

Genotypes at six polymorphic allozyme loci and survivorship were measured for *Eisenia andrei* raised in all combinations of three soil moistures (2, 3, 4 ml H₂O/ g dry peat moss) and four soil temperatures (15, 20, 25, 28°C). Temperature and moisture had a significant interactive effect on survivorship (weeks to 50% mortality; F = 167.6; df = 11, 1030; P < 0.0001). Low temperature promoted survivorship, and high moisture had a positive effect at low temperatures but a negative effect at high temperatures. There was a significant effect of temperature and moisture on heterozygosity at individual loci (Wilkes' Lambda = 0.90; F = 1.58; df = 66, 5490; P < 0.005) and on multilocus heterozygosity (F = 3.19; df = 11, 1030; P < 0.005), even though single locus patterns were not absolutely consistent among loci. Assuming that the distribution of heterozygosities was uniform in the temperature X moisture space prior to any mortality, multilocus heterozygotes had greater survivorship in moderate temperature environments (~20°C) than multilocus homozygotes. Multilocus homozygotes had greater survivorship at the temperature extremes. Individuals that are more heterozygous may have fitness advantage over more homozygous individuals in moderately stressful environments that enhance the subtle effects of heterozygosity.

- 204 WHITE, CHRISTINE AND ISAURE DE BURON. Converse College, Spartanburg, SC 29302 – Histological alterations of equine placenta due to fescue toxicosis.

Altered reproductive performance in mares due to "fescue toxicosis" has been increasingly recognized as a problem in equine breeding circles. This condition is found in mares that feed on endophyte-infected fescue grass during their last trimester of gestation and is associated with several complications, including difficulty in foaling. Common speculation has been that an increase of placental thickness makes this tissue more resistant and prevents foals from breaking through it. However, to our knowledge, no study has been undertaken to tabulate the placental thickness at a microscopic level. Therefore, the objective of this project was to prepare mare placenta histologically in order to determine the effects of fescue toxicosis on placental thickness. Placenta samples were taken from mares fed during their last trimester on infected fescue grass (treatment), non-fescue grasses (control 1), and infected fescue grass with the addition of mare drug treatment using domperidone (control 2). Four mares were studied in each group. Thirty-six thickness measurements were taken of each placenta from digital images using an Image Analysis System. Though these results indicated a trend toward thickening in the mares fed on infected fescue, there was not a statistically significant thickening in these mares, which contradicted the common expectation. This project was supported by a grant from Independent Colleges and Universities of South Carolina, Inc.

- 205 WILSON, BARBARA L. AND WM. DAVID WEBSTER. Dept. Biological Sciences, University of North Carolina at Wilmington, Wilmington, NC 28403-3297 - Microhabitat selection in the eastern woodrat, *Neotoma floridana* (Mammalia: Rodentia: Muridae), in the northeasternmost part of its geographic distribution.

The eastern woodrat (*Neotoma floridana*) is distributed throughout the southeastern United States, but the U.S. Department of Interior considers it to be a Species-at-Risk because its habitat is rapidly disappearing due to mining, tree farming, and development activities. We examined microhabitat selection in *N. floridana* in coastal North Carolina, the northeasternmost part of its geographic distribution, where shallow marine deposits of Eocene limestone render the soil circumneutral. This atypical soil association supports a rich mesic forest characterized by dwarf palmetto (*Sabal minor*) and the eastern woodrat, a soil/plant/animal association that is more commonly found in Florida. Woodrats were live-trapped, sexed, weighed, and released, and their fecal pellets were recovered for food habit analysis. Woodrat nests, used as an index of woodrat density, were significantly more abundant in microhabitats where soil pH exceeded 6.5, where palmetto was denser and overall shrub coverage was greater, where the circumference of subcanopy trees was large enough to support the woodrat's elaborate nests, and where herbaceous cover and density was sparser. This research was sponsored by the U.S. Geological Survey's Species-at-Risk Program and UNCW's Center for Marine Science Research.

- 206 JEFFRIES, MICHAEL N.¹, TIMOTHY J. GAUDIN¹, AND WILLIAM P. STEVENS². ¹Dept. of Biological & Environmental Sciences, University of Tennessee at Chattanooga, Chattanooga, TN 37403 and ²Dept. of Biology, Georgetown College, Georgetown, KY 40324 - Biogeography of the short-tailed shrew (*Blarina brevicauda* and *B. carolinensis*) in the Tennessee River Valley and adjacent areas of the midsouth.

Several recent studies have investigated the distribution within the southeastern United States of the two most widespread species of short-tailed shrew, the large-bodied Northern short-tailed shrew *Blarina brevicauda* and the smaller Southern short-tailed shrew *B. carolinensis*. These studies concur that *B. brevicauda* is largely restricted to the Blue Ridge physiographic province of Tennessee, Georgia and the Carolinas and the Piedmont and Central Highlands of Georgia and Tennessee respectively, whereas *B. carolinensis* occurs in piedmont and coastal plain regions throughout the southeast, as well as the Mississippi lowlands of western Tennessee and Kentucky. The Tennessee River Valley and adjacent Ridge and Valley and Cumberland Plateau regions of southeastern Tennessee have been poorly sampled, and yet preliminary surveys indicate the presence of animals of intermediate size in these regions. Ten cranial measurements were taken on a series of museum specimens collected throughout the southeast, including an extensive collection of *Blarina* from southeastern Tennessee. A preliminary principal components analysis of cranial measurements on 104 specimens from Georgia resulted in clear separation of the two species based on size, but no significant shape differences aside from the allometric effects of overall size. The analysis will be extended to include specimens from the entire 5 state region (TN, GA, AL, NC & SC) and to include mandibular and dental measurements, which may allow classification of specimens of intermediate size.

- 207 GAUDIN, TIMOTHY J. AND JEREMY L. BRAMBLETT. Department of Biological and Environmental Sciences, University of Tennessee at Chattanooga, Chattanooga, TN 37403. Preliminary Report on Late Pleistocene Bats from Lookout Mountain, Tennessee.

Recent paleontological fieldwork conducted in caves at Lookout Mountain, Tennessee has yielded a diverse and abundant microvertebrate fauna including: fish, frogs, salamanders, lizards, snakes, birds, and mammals. These sites have yielded several extinct (e.g., *Dasyatis bellus*, *Mylohyus* sp., and *Mammuth americanum*) and extirpated (e.g., *Condylura cristata* and *Conepatus leuconotus*) taxa that can be assigned to the late Pleistocene. By far the most abundant taxa recovered are bats. A large quantity (>10,000 elements) of extremely well preserved bat fossils has been recovered from these sites. This collection represents a unique opportunity to better understand late Pleistocene bat populations in southeastern Tennessee. In addition, these caves are presently devoid of any significant bat populations, providing the opportunity to investigate how bat populations have responded to climatic and anthropogenic environmental changes over the past 10,000 years. A taxonomic key employing a suite of meristic characters of the lower jaw was written based on analysis of Recent southeastern bat species. Using this key we have identified to species over 50 bat lower jaws. This sample is dominated by well-known cave dwelling species, especially *Eptesicus fuscus* and *Myotis* sp. but also includes a surprisingly large number of uncommon or endangered taxa [*Myotis grisescens* (E), *M. sodalis* (E), *M. septentrionalis*, *Pipistrellus subflavus*, and *Corynorhinus rafinesquii*] and new Tennessee Pleistocene record for the arboreal genus *Lasiurus*. Several hundred additional specimens are presently being identified.

- 208 STEWART, KEVIN D., AND RICHARD M. DUFFIELD. Dept. Biology, Howard University, Washington, D.C. 20059 - *Sialis vagans* (Ross) (Megaloptera: Sialidae) trapped by Mountain Laurel (*Kalmia latifolia* L.) (Ericaceae).

At a small impoundment in Frederick City Municipal Forest along Little Fishing Creek (Frederick Co., Maryland), numerous adult alderflies, *Sialis vagans* (Ross), were found stuck to the stems of individual flowers of two mountain laurel bushes (*Kalmia latifolia* L.). Some were immobilized by their tarsi and

others by their wings to the corolla of the flowers. Many of the alderflies were still alive. The two bushes along the margin of the pond had 25 and 97 floral clusters, with 22 and 27 alderflies, respectively. A third bush below the outlet of the pond had 18 floral clusters. No alderflies were found stuck to the flower clusters of the third bush, but 10 stoneflies, *Amphimura nigruta* (Prov.) (Plecoptera: Nemouridae), were recovered from the floral clusters. It is not clear how the alderflies and the stoneflies moved to the mountain laurel flowers. This novel observation may prove useful to collectors. Additional observations may increase the list of taxa that can be collected from mountain laurel flowers. Supported by the Forest Biology and AMP Programs at Howard University. Mr. Stewart is a recipient of an EPA undergraduate Fellowship.

209

SIEGLE, TRACEY E. AND ELAINE S. CHAPMAN. Department of Biology, The Illinois College, Jacksonville, IL 62650- A preliminary survey of tick populations in rural Pike Co., Illinois.

A preliminary survey of tick populations at a rural site in Pike Co., Illinois, is reported. Two tick species, *Amblyomma americanum*, the lone star tick; and *Dermacentor variabilis*, the American dog tick were collected using chemical attractant (CO₂; dry ice block) and by means of dragging (ten 1 x 50 m transects). Interestingly, most ticks were collected on or adjacent to an unoccupied private wooden residence. Following identification, about 75% of the ticks were analyzed for the presence of disease-causing organisms; all were pathogen-free. With only a very small number of *A. americanum* recovered, our results also refute earlier reports that suggest *A. americanum* is expanding its range farther north from Missouri. Because both tick species are known disease carriers (*i.e.*, tularemia, human monocytic ehrlichiosis, Rocky Mountain spotted fever, Q fever), our results have a practical application for recreational and residential activities in Pike Co.

210

REEVES, WILL K. Dept. of Entomology, Clemson University-Seasonality in southeastern cave invertebrates.

Many temperate region invertebrates show some seasonal and circadian rhythms. However, cave dwelling invertebrates are frequently cited as aseasonal in activity. I will present data on the natural history of cave invertebrates (flies, beetles, millipedes, spiders, harvestmen, and isopods) from southeastern caves. This data will be discussed in the context of the seasonal environmental parameters and the cave environment. My data indicate that some cave invertebrates such as the leioidid beetles show distinct seasonal activity.

211 HAMILTON, ROBERT IV¹, JANET W. REID², AND RICHARD M. DUFFIELD¹.

¹Dept. Biology, Howard University, Washington D.C. 20059 and ²Dept. Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560 - Novel copepod abundant in leaves of *Sarracenia purpurea* L.

One hundred and fourteen *Paracyclops canadensis* (Willey) (Copepoda:Cyclopoida) were recovered from 660 leaves of the purple pitcher plant, *Sarracenia purpurea* (Sarraceniaceae) sampled from ten geographically separated sites between March 11, 1996 and November 11, 1997. Specimens included immatures and males and female adults. Most copepods were alive when collected. *Paracyclops canadensis* is not common in collections and is considered rare. This report documents that *P. canadensis* is more widespread and prevalent than previously thought. Its relatively high frequency in *S. purpurea* leaves suggests it has a species-specific association with this pitcher plant. The material in this study represents the most widespread collection of *P. canadensis* in North America. Sponsored by the USDA - Forest Service (Eastern Region) and Howard University.

212 WILLIAMS, RAY S. Dept. Biology, Appalachian State University, Boone, NC 28608 - Responses of the gypsy moth to elevated CO₂ and temperature grown maple species.

To investigate whether increases in atmospheric CO₂ and temperature could alter significant tree-herbivorous insect interactions, red and sugar maple were grown in open-top chambers under two CO₂ (ambient and +300

ppm) and temperature (ambient and +3.5 °C) treatments. First instar F₁-sterile gypsy moth larvae were placed on the plants within chambers and various performance parameters assessed. Phytochemical constituents were quantified from collected leaf samples. In both maple species, leaf nitrogen concentration declined and non-structural carbohydrates and carbon:nitrogen ratio increased in leaves grown under elevated CO₂, while temperature had no effect on these measures. Carbon-based phenolics were unaffected by either treatment. Insect responses on sugar maple included an increase in larval growth and consumption on plants grown at elevated temperature. For red maple- larvae feeding at elevated temperature reached pupation 5-8 days before those feeding at ambient temperature. The concentration of CO₂ had no affect on days to pupation nor pupal fresh weight. These results suggest that the direct effects of elevated temperature may be more important than reductions in leaf quality due to CO₂-enrichment.

- 213 LUCE, AUSTINE A., CROWE, MARY. Department of Biology, Coastal Carolina University, Conway, SC 29528 - Investigations into the behavior and ecology of juvenile ghost crabs, *Ocypode quadrata*

Ghost crabs, *Ocypode quadrata*, are semi terrestrial crabs that fulfill a variety of ecological roles on beaches. Most of the research on ghost crab behavior and ecology has been done with adults. In this study we documented juvenile behavior and burrow location on an undeveloped barrier island in South Carolina. Although juvenile crabs exhibit the same behaviors as adults they differ in the amount of time they spend unplugging and moving in the ocean. Juvenile ghost crab burrows are more likely to occur within the first 10 meters of the surf.

- 214 HANEY, DENNIS C. AND WADE W. WORTHEN. Department of Biology, Furman University, Greenville SC 29613 - Temperature tolerance in three mycophagous *Drosophila* species: relationships with community structure.

Patterns of host use at several spatial and temporal scales suggest that temperature tolerance may influence the structure of mycophagous fly communities. For instance, *Drosophila putrida* is more abundant than *D. falleni* and *D. tripunctata* in dry sites, at dry periods, and in small, desiccation prone mushrooms. In this experiment, we acclimated flies from these species at different temperatures (15°C, 20°C, 25°C, and 30°C) for five days, and then measured their responses to acute thermal stress (increasing temperature 0.5°C/minute). ANOVA were used to describe the effects of sex, species, and acclimation temperature on: 1) survivorship after five days, and 2) Critical thermal maximum (CTMax). Critical thermal maximum was measured as the temperature at which 50% of the flies in a sample were incapable of righting themselves. Survivorship was uniformly high for all species from 15-25°C. However, at 30°C, *D. Putrida* survival (74%) was significantly higher than either *D. falleni* (39%) or *D. tripunctata* (23%). When averaged across all acclimation temperatures, *D. putrida* also had a higher CTMax than the other species (40.7°C, compared to 40.2°C for *D. falleni* and 39.9°C for *D. tripunctata*). *Drosophila putrida* was the only species with a CTMax that increased significantly after acclimation at 30°C. Thus, *D. Putrida* was more tolerant to chronic and acute thermal stress than the other species, and it was the only species to show an adaptive physiological response to high temperature exposure. These species differences are consistent with spatial and temporal abundance patterns, and may contribute to patterns in community structure.

- 215 JIN, EUN-JUNG AND GISELLE THIBAUDEAU. Mississippi State University - LiCl-induced phosphoprotein involved in pigment development in the embryonic zebrafish (*Brachydanio rerio*).

The embryonic zebrafish (*Brachydanio rerio*) is rapidly becoming an important model organism for studies of early events in vertebrate development. Neural crest-derived pigment cell precursors of the embryonic zebrafish give rise to melanophores, xanthophores, and/or iridophores. Cell-signaling mechanisms related to the development of pigmentation and pigment pattern formation remain obscure. Previous studies demonstrated a LiCl-induced increase in gross pigmentation in embryonic zebrafish. In this study, zebrafish embryos were treated with various signaling-related molecules – LiCl, (an inositol-phosphatase inhibitor), forskolin, (a protein kinase-A activator), a combination of LiCl/forskolin, and LiCl/heparin. (an IP₃ inhibitor) in order to identify mechanisms involved in pigmentation of embryonic zebrafish. LiCl treatment resulted in ultrastructural and morphological alterations of melanophores. To identify the possible proteins responsible for this ultrastructural and morphological change, *in vitro* and *in vivo* phosphorylation patterns were

analyzed. LiCl and LiCl/forskolin treatment elicited dramatic increases in the phosphorylation of a 55-kDa protein which was inhibited by heparin treatment. LiCl treatment of melanophores purified from zebrafish scales also resulted in the increased phosphorylation of a 55-kDa protein. Collectively, results suggest that a LiCl induced-55-kDa phosphoprotein plays a role in melanophore morphology and ultrastructure, ultimately effect gross pigmentation.

216

VAN VALKENBURG, DOUG, AND DWAYNE WISE. Department of Biological Sciences, Mississippi State University, MS 39762-Evidence for the alteration by B chromosomes of the metaphase checkpoint in meiotically dividing cells of a species of grasshopper.

In populations of the Spanish grasshopper, *Eyprepocnemis plorans*, there is a widespread polymorphism of B chromosomes. Of these B chromosomes, there seem to be a few original chromosomes and several variants derived from them. The B1 chromosome is an original form and has given rise to several variants, including the B5 chromosome. Using immunofluorescence cytochemistry and confocal laser microscopy, B1 chromosomes have been shown to produce a different phosphorylation pattern than the pattern produced in meiotically dividing cells without B chromosomes. This change in phosphorylation pattern indicates a possible change in the metaphase checkpoint. The B5 variant also seems to alter the phosphorylation pattern of meiotically dividing cells, which indicates that it also could alter the checkpoint.

217

KUPFER, HOLLY AND DWAYNE WISE. Mississippi State University - The sex chromosomes of flea beetles achieve proper orientation and segregation during meiosis without change in tension.

In the flea beetle, *Alagoasa bicolor* L., males have two nonhomologous, achiasmate (unconnected) sex chromosomes (Y and Y) that consistently segregate to opposite spindle poles. The sex chromosomes begin prometaphase commingled with the autosomes. Once spindle formation is completed, the autosomes occupy the center of the cell and the sex chromosomes are peripheral. Apparently, two separate spindle domains are generated. As meiosis progresses, the sex chromosomes become syntelically oriented towards opposite poles. In orthodox meiosis, the chiasma, along with tension placed on the kinetochores by microtubule attachments to the spindle poles, stabilizes bivalents and ultimately guarantees that homologues segregate properly. Tension placed on the kinetochores can be detected by a phosphorylation-dephosphorylation signaling mechanism using the monoclonal antibody 3F3/2. Using this antibody, we have analyzed the degree of phosphorylation of the sex chromosome kinetochores. There was no change in the fluorescence intensity of these two kinetochores at any stage of reorientation. Therefore, we believe the proper orientation and segregation of the sex univalents do not involve changes in tension generated at the kinetochore.

218

BRUNNER, JESSICA J., RICHARD N. HENSON, AND MARY U. CONNELL. Appalachian State University - The reevaluation of *Diplocentrus* sp. using molecular techniques.

The scorpion genus *Diplocentrus* Peters is often described as "a poorly understood assemblage of scorpions in the United States ranging through Texas, New Mexico, and Arizona." Currently there are two described species and one known undescribed species of *Diplocentrus* in the state of Texas: *Diplocentrus whitei* Gervais, *Diplocentrus diablo* Stockwell, and *Diplocentrus* sp. (an undescribed species). Due to the limited knowledge of this scorpion family, Diplocentridae, and the eight Texas county range of this undescribed species, the possibility exists that more than one undescribed species is represented by *Diplocentrus* sp. Initial studies comparing morphometrics of specimens of this undescribed species across its known range in Texas have shown that there actually may be two or more separate species. The objective of this proposed study is to look at *Diplocentrus* sp. and try to determine if a 500 base pair sequence on the mitochondrial 16S rDNA can be used to separate the Texas species. Partial support for this project is funded by BGSA and the Research Office of the Cratis D. Williams Graduate School.

- 219UPCHURCH, ROBERT A., KIM NORRIS-CANEDA, AND JESSICA YOUNG. Dept. Biology, Coastal Carolina University, Conway, SC 29528 - Using molecular sexing identification to aid raptor rehabilitation.

Most species of raptors have no external or behavioral characteristics which distinguish them from males or females. Management and treatment of rehabilitated raptors can be aided if the sex of the individual is ascertained. A general technique for sexing birds from blood samples has been developed by other investigators. I have involved the use of this technique in collaboration with the S.C. Center for Birds of Prey to sex a variety of raptor species. Protocols have been designed to identify gender across 14 species and approximately 200 individuals.

- 220 MARSHALL, HAROLD¹ AND LUBOMIRA BURCHARDT². ¹Dept. of Biological Sciences, Old Dominion University, Norfolk, VA 23529 and ²Dept. of Hydrobiology, Adam Mickiewicz University, Poznan, Poland - Phytoplankton dynamics within the tidal freshwater region of the James River, Virginia.

Based on a 10.5 year data base, 271 taxa were identified in this segment of the river. This region of transition contained diverse and abundant river flora with seasonal succession and composition influenced by periods of changing river flow rates. Freshwater assemblages dominated the flora. Diatom maxima were associated with peak periods of river discharge. Greater abundance in chlorophytes, cyanobacteria, and autotrophic picoplankton, plus greater productivity, occurred during periods of reduced river flow and more stable water conditions. Estuarine species, transported by sub-pycnocline flow, occurred infrequently and in low concentrations. *Skeletonema potamos* and several other centrics were among the dominant flora, with increased concentrations of cyanobacteria, chlorophytes, cryptophytes, and euglenoids producing highest biomass levels during the summer and fall months. This study was supported by the Virginia Department of Environmental Quality.

- 221 WOLNY, JENNIFER, DAVID SEABORN, AND HAROLD MARSHALL. Dept. of Biological Sciences, Old Dominion University, Norfolk, VA 23529 - Results of a distribution survey for *Pfiesteria piscicida* and similar dinoflagellates in Virginia estuaries.

During the summer – fall 1998 over 1800 water samples from 168 sites in Virginia estuaries were screened for the presence of *Pfiesteria piscicida* and dinoflagellates closely resembling *P. piscicida* in size, shape, and morphology. Samples were collected biweekly and during fish kills and fish lesion events. Dominant species found during the screening process were *Cryptoperidiniopsis* sp., *Gymnodinium* sp. and *Gyrodinium* sp., all *Pfiesteria*-like dinoflagellates. Subsequent analysis with scanning electron microscopy did not show the presence of *Pfiesteria piscicida* in the waters sampled. Presence of *Pfiesteria*-like dinoflagellates, however, were widely distributed in Virginia estuaries, occurring in 44% of the samples at 85% of the sites collected through the course of the study. Sediment analysis showed that 83% of the sediment samples analyzed had complex members in them. Virginia Departments of Health and Environmental Quality, EPA, and CDC provided support for this study.

- 222 KOKOLIS, MICHELLE, DAVID SEABORN, JENNIFER WOLNY, AND HAROLD MARSHALL. Dept. of Biological Sciences, Old Dominion University, Norfolk, VA 23529 - The composition and long term trends associated with phytoplankton assemblages in the lower Chesapeake Bay.

Since 1985, the composition and abundance of phytoplankton in the lower Chesapeake Bay have been monitored on a monthly basis, with recent emphasis on water quality indicators and toxin producing species. During this time over 700 species, including 12 toxin producers, have been identified in the lower Bay. Using the Seasonal Kendall test

for monotonic trends and the Van Belle and Hughes tests for homogeneity, several trends were noted. Diatoms and several phytoflagellate groups have been identified as the dominant flora, with seasonal abundance maxima occurring in early spring and fall. The maximum autotrophic picoplankton concentrations were seen in the summer. During the past 13 years there has been an increase in overall abundance as well as an increase in diatom and bloom producing dinoflagellate biomass. Autotrophic picoplankton abundance and species diversity has decreased since 1985. This project was supported by the Virginia Department of Environmental Quality.

- 223 SCHNITTLER, MARTIN AND STEVEN L. STEPHENSON. Dept. Biology, Fairmont State College, Fairmont, WV 26554 - Myxomycete biodiversity in four different forest types in Costa Rica.

The moist chamber culture technique was used to study the myxomycetes associated with four different forest types in northwestern Costa Rica. Although our study (with 497 total cultures) was one of the most comprehensive surveys of its type ever carried out, a statistical analysis showed that completeness in terms of the total number of species present was still not reached. The most obvious reason is the apparent rarity of many myxomycete species, a phenomenon well known for other groups of organisms from tropical ecosystems. The low average yield of the moist chambers (mean = 1.04 species/culture, 56% positive cultures) reflects this fact. Dramatic differences in myxomycete diversity were encountered among the forest types, which are arranged roughly along an elevation gradient. The two seasonal dry forest types, semideciduous and evergreen lowland forest, accounted for 97% of the total species diversity. Corticolous myxomycetes have a clear abundance and biodiversity peak in the seasonal dry semideciduous forest, with trees of various bark types. In montane rainforest and cloud forest, where trees have uniformly smooth bark densely covered with epiphytes, abundance and diversity dropped to almost zero. Litter myxomycetes have their optimum in the seasonal dry evergreen forest. Aerial litter (mean = 1.78 species/culture) was distinctly richer in myxomycetes than forest floor litter (mean = 1.08 species/culture).

- 224 RISK, ALLEN C. Morehead State University - Kentucky's moss flora. additions and noteworthy collections.

Ongoing inventory efforts in eastern Kentucky have resulted in the discovery of five previously unrecorded taxa for the state and numerous new county records for mosses rare in Kentucky. *Bryum minutum*, *Ephemerum serratum*, *Phascum cuspidatum*, *Physcomitrium collenchymatum*, and *Sphagnum bartlettianum* are additions to the state bryoflora. Rare taxa for which new localities have been found include *Anomodon rugelii*, *Campylostelium saxicola*, *Cirriphyllum piliferum*, *Dichodontium pellucidum*, *Herpetineuron toccoeae*, *Leucodon brachypus*, *Neckera pennata*, *Oncophorus raii*, *Polytrichum pallidisetum*, *Racomitrium aciculare*, and *Sphagnum magellanicum*.

- 225 ROMAIN, REGINALD AND L. FREDERICK. Howard University, Washington, DC - *Chaetomium* sp. as a probable cause of a leaf spot of *Ficus lyrata*.

Purple leaf spots, 1.5 to 3 mm dia. with minute light tan central areas were noted on several upper leaves of a four foot tall potted *Ficus lyrata* plant that was growing outdoors, during mid-summer and early fall, under a small tree. The spots were widely dispersed over the leaf surface with as many as 90 present on some leaves. These leaf spots did not cause severe necrotic lesions and leaf abscission of infected leaves did not later occur when the plant was placed in a greenhouse. Leaf sections containing spots were excised from several leaves, surface sterilized, minced under aseptic conditions, and plated onto potato-dextrose agar plates in an attempt to isolate any probable causal agent. Two fungal isolates were obtained. One, a species of *Chaetomium*, was of most frequent occurrence. A species of *Alternaria* was also isolated but developed only from a small number of the leaf pieces plated. *Alternaria* is one of nine species of fungi that are reported to cause leaf spots on *F. lyrata*. It does not appear that any species of *Chaetomium* has been reported to be associated with any disease of this plant. Preliminary attempts have been made, with limited success, to infect disease-free leaves of other *F. lyrata* greenhouse plants with the *Chaetomium* isolate. (Study supported by NSF-AMP award to Howard University)

226 TOURE, OUMAR¹, RAYMOND L. PETERSEN¹, AND PAMELA J. EDWARDS².

¹Dept. Of Biology, Howard University, Washington, DC 20059 and ²USDA Forest Service, Northeastern Research Station, Parsons, WV 26287 - The apparent adaptation of the pigeon moss, *Polytrichum commune* Hedw. (Polytrichaceae) to soils affected by acid mine drainage.

The moss *Polytrichum commune* is one of a few plants found abundantly on sites affected by acid mine drainage (AMD). As such, the apparent adaptation of *P. commune* to the extreme edaphic conditions of AMD-sites was investigated. The spores of *P. commune* collected from an AMD-site (Tub Run, Tucker County, WV) and from a nearby non-polluted site were subjected to a double dilution experiment and assessed for: (1) spore germination, (2) protonematal growth, and (3) gametophore production. These findings were compared to water and soil chemistry of the AMD-site and the non-polluted sites. The AMD-water had a pH of 4.2 and very high sulfate and iron concentrations. Heavy metals, including Mn, Hg, Pb, Cu, and Zn were present, some at levels known to be toxic to *P. commune*. In undiluted AMD-water, spore and gametophore production, and protonematal growth of *P. commune* from the AMD-site exceeded that of the non-polluted *P. commune*. With dilution of the AMD-water, germination of *P. commune* from the non-polluted site equaled that from the AMD-site, and protonematal growth and gametophore production exceeded that from the AMD-site. Thus, *P. commune* from Tub Run apparently has adapted evolutionarily to the AMD-influenced edaphic conditions, whereas it competes less well in less polluted conditions in which it has not developed. Acknowledgments: Research supported by the USDA Forest Service (Eastern Region) and Howard University.

227 RISK, ALLEN C. Morehead State University - Bryophytes of the Obed Wild and Scenic River, Tennessee.

The Obed Wild and Scenic River (OWSR) is a unit of the National Park System located in the Cumberland Plateau of Tennessee. The park is comprised of approximately 5000 acres along 46 stream corridor miles of the Obed River, Clear Creek, and Daddys Creek. Topographically, the region is characterized by a broad upland punctuated by sandstone gorges. The present study documented 220 species of bryophytes for the OWSR. Two moss species not previously known from Tennessee, *Brachythecium populeum* and *Fissidens ravenelii*, were found during the study. Taxa uncommon in the Cumberland Plateau and found in the OWSR include *Anastrophyllum michauxii*, *Herbertus aduncus*, *Blindia acuta*, *Cirriphyllum piliferum*, *Herpetineuron toccoea*, *Oncophorus raii*, *Polytrichum pallidisetum*, and *Zygodon viridissimus* var. *rupestris*.

228 FAUST, ANDRÉA AND RAYMOND L. PETERSEN. Dept. of Biology, Howard University, Washington, DC 20059 - Age estimates of colonies of the cinnamon fern, *Osmunda cinnamomea*.

While abundant information is available on the ages of woody plant species, usually based on annual growth rings and clonal system analysis, there is little information on the ages and longevity of ferns. In this study the ages of several colonies of the cinnamon fern *Osmunda cinnamomea* were estimated. *Osmunda cinnamomea* forms elliptical-donut shaped colonies. In the Monongahela National Forest, West Virginia, where this study was conducted, colonies in excess of 2 meters in diameter were observed. These large colonies were comprised of dozens of ramets, all inter-connected by a subsurface dichotomously branching rhizome system. The preferred habitats for the cinnamon fern are sunny bog margins and open and moist woodlands and roadsides. Fronds emerge in the early spring, function through the growing season, and die back with the onset of fall; however the stipe bases of the frond persist year after year on their subsurface rhizomes. Age estimates were based on the average number of fronds produced per ramet per colony (genet), the rhizome length, and the number of persistent stipe bases. Based on the data, some age estimates in excess of 500 years were detected. Acknowledgements: Research supported by the USDA Forest Service (Eastern Region) and Howard University.

229 NURCAHYANI, NUNING AND GISELLE THIBAudeau. Mississippi State University - Spatial influences on neural crest-derived pigment cell differentiation and migratory activities.

Neural crest cells give rise to a diversity of cell types, including all dermal and epidermal pigment cells. Although many mechanisms control neural crest cell development, specific influences that affect each

neural crest cells differentiation abilities and migration remain unknown. Here we present in vitro studies designed to identify 1) potential sources of the differentiation bias previously observed in neural crest cells originating from different levels along the anterior/posterior axis in the axolotl and 2) potential preferences among the individual chromatophore types during lineage restriction events. Neural crest cell cultures were used to observe neural crest cell activities as cells migrate away from the explant and differentiate into an appropriate cell type. Similar to previous in vitro studies, we found that under minimal culture conditions cell populations from the posterior-most region of the crest give rise to more melanophores than other axial regions. Data indicate that temporal and spatial differences in the axolotl neural crest determine chromatophore differentiation preferences. More specifically we discriminate between the various cellular parameters including cell density, time of migration, and migration rate that may contribute to the differentiation bias seen in vitro. Here we present evidence identifying those parameters that influence the region specific responses observed in neural crest-derived pigment cell lineages.

- 230 RAYBURN, JAMES R. Dept. of Biology, Jacksonville State University, Jacksonville, AL.
- The Use of the Grass Shrimp *Palaemonetes pugio* Toxicity Assay for the Identification of possible population differences.

Identification of different populations of the Grass Shrimp, *Palaemonetes pugio*, was performed using a developmental toxicity test. Grass shrimp were collected from several different sites around northeast Florida and one site in Beaufort, North Carolina and brought to the EPA Lab in Gulf Breeze Florida. They were maintained in laboratory conditions for at least 2 weeks before embryos were taken for toxicity testing. By investigating these differences in toxic responses of embryos, we showed that shrimp collected from different sites apparently had different responses to ethanol toxicity. Ethanol was chosen because of the laboratory had a history using ethanol as a reference toxin for the toxicity test using the grass shrimp. Three different toxicity tests were performed within each population. We do not know if differences were associated with field exposure or laboratory holding procedures. We do know that toxicity tests can be used to show differences in grass shrimp populations in general.

- 231 ROBERSON, CAROLYN, EUN-JUNG JIN, AND GISELLE THIBAUDEAU. Mississippi State University- Analysis of melanophore differentiation in zebrafish under normal and treated conditions.

Pigment pattern in zebrafish (*Brachydanio rerio*) results from the organization of three different pigment cell types: melanophores (contain melanin), xanthophores (contain yellow pigment), and iridophores (contain reflecting platelets). At about 72 hours post-fertilization, all three pigment cell types are expressed in the zebrafish, and continue to differentiate throughout development. Previous studies indicate the existence of two populations of melanophores (early and late), and their presence is dependent upon their time of differentiation. This study was designed to investigate these early and late populations of melanophores *in vivo* under normal and treated conditions. We examined a developmental series of zebrafish embryos and larvae in order to record the time of differentiation and the location of melanophores. Data suggested an initial increase in melanophore differentiation up to three days, followed by a second round of melanophore differentiation around 14 days. Differences in melanophore morphology were seen in the normal development of three day, 1 week, and 2 week larvae. Treatment of zebrafish embryos with forskolin/LiCl caused a significant increase in gross pigmentation of five-day larvae. Histological sections of treated vs. untreated larvae revealed morphological differences in melanophore populations. We suggest that these morphological differences represent different migratory states and/or differentiation events during early pattern formation.

- 232 CAMPO, FRANK M.¹, GARY P. SHAFFER¹, MARK W. HESTER¹, AND DANIEL W. LLEWELLYN². ¹Dept. Biological Sciences, SLU 10736, Southeastern Louisiana University, Hammond, LA 70402 and ²LA Dept. Natural Resources, Coastal Restoration Division, 625 N. 4th St., PO Box 94396, Baton Rouge, LA 70804-9396- In Situ hurricane simulations on two age classes of baldcypress (*Taxodium distichum* (L.) Richard) seedlings.

This study was conducted to evaluate the effects of *in situ* simulated hurricane-induced salinity pulses on different age classes of baldcypress seedlings as a possible factor limiting the successful regeneration and growth of baldcypress in the Lake Maurepas / Pass Manchac area of southeast Louisiana. An extreme high tide event created by a tropical storm (August 1994) flooded the area with low salinity water that was utilized in this study. Large plastic cylinders were inserted into the substrate around previously planted 18-month and 42-month old baldcypress seedlings and salinity pulses (0.9 -10 ppt) were simulated by adding sea salts to the flood water within the cylinders. Photosynthetic rates of both age classes decreased with increasing salinity. The 18-month old seedlings exhibited stable diameter growth across salinity treatments, whereas the older 42-month old seedlings displayed enhanced diameter growth in the 5 and 10 ppt treatments. Interestingly, there was not a single case of seedling mortality. This experiment was replicated in 1998 and extended through the implementation of a broader range of salinity pulses (5 ppt, 10 ppt, 15 ppt, and 20 ppt) and measuring xylem pressure in addition to previously mentioned variables. The results of this experiment reinforced previous evidence that 42-month old seedlings are more tolerant to saltwater flooding than 18-month old seedlings, demonstrated by higher photosynthetic rates and less negative xylem pressure.

- 233 WILLIS, JONATHAN M. AND MARK W. HESTER. Dept. of Biological Sciences, Southeastern Louisiana University, Hammond, LA 70402 - Effects of salinity, flooding depth, and soil organic content on *Panicum hemitomon* adventitious root production and biomass partitioning.

High levels of salinity from salt water intrusion can kill fresh marsh plants and result in loss of fresh marsh area. Small degrees of salinity may negatively impact fresh marsh accretion by impairing production of adventitious roots. A greenhouse study was initiated where *Panicum hemitomon* were subjected to three salinity levels (0, 1.5, 3.0 ppt), three hydrologies (Flooded to the soil surface, to 0 cm above the soil surface, and to 20 cm above the soil surface), and two organic soil levels (low and high) in order to determine the effects of these factors on adventitious root production and biomass partitioning in this species. No significant differences in mortality were observed between salinity levels. However, plant biomass was lower at 1.5 and 3.0 ppt salinity than at 0 ppt salinity. Plant biomass was also lower in the high organic soil compared to low organic soil. Redox potential was lower in the low and high flooding conditions than in moist conditions. Adventitious root production was observed in both low and high flooding treatments, with a tendency toward less production with increasing salinity. These data indicate that there is a negative effect on this species growth and allocation patterns at salinity levels as low as 1.5 ppt or 3.0 ppt. These findings may have serious implications for the distribution and abundance of *P. hemitomon* marsh under various global sea-level rise scenarios.

- 234 HESTER, MARK, W.¹ AND IRVING A. MENDELSSOHN². ¹Dept. of Biological Sciences, Southeastern Louisiana University, Hammond, LA 70402 and ²Wetland Biogeochemical Institute, Louisiana State University, Baton Rouge, LA 70803 - Long-term vegetative recovery from an oil spill in a Louisiana salt marsh: experimental manipulations of elevation and sediment.

A break in an oil pipeline resulted in the release of approximately 330 barrels of Louisiana crude oil into a salt marsh in southeast Louisiana. The spill was confined to a 20 ha area and resulted in a 64% reduction of live vegetative cover. Four years later the majority of the site showed near-complete vegetative recovery, with the exception of two smaller areas within the site that never revegetated and became shallow-water ponds. Experimental plots were established in these areas to assess whether the failure of these areas to revegetate was due to a residual oil effect or a water depth too stressful for recolonization. At each area elevated plots were established to the natural elevation of the adjoining marsh surface by filling them with sediment either from that area (which had been previously oiled) or from an unoiled adjacent marsh. Other plots were left at the ambient elevation of the shallow pond bottom. All plots were planted with transplants of *Spartina alterniflora*. After 16 months the experiment was harvested. Aboveground and belowground biomass, as well as numbers of live and total stems, were significantly greater in the elevated plots regardless of sediment type. Ambient elevation plots displayed more reduced soil conditions as evidenced by more negative soil redox potentials and greater concentrations of interstitial sulfides. Therefore, failure of certain areas to revegetate following an oil impact may be due to decreased marsh surface elevations and increased flooding stress.

235

- SHAFFER, GARY P., RACHEL A. DOWTY, MARK W. HESTER, GARY W. CHILDERS, MICHAEL C. GREENE, AND FRANK M. CAMPO. Southeastern Louisiana University – Bioremediation of small-scale oil spills in fresh marsh habitats: a mesocosm approach.

An 18-month study was conducted to test the efficacy of techniques that may enhance the bioremediation of crude oil spills in fresh marshes while minimizing secondary anthropogenic impacts. To emulate field

conditions, a mesocosm facility was constructed that housed one hundred and twenty 200-liter vessels. A five-way factorial treatment arrangement was used that included two substrates (organic, inorganic), two nutrient regimes (fertilized, not fertilized), two aeration levels (substrate aeration, no aeration), three oiling concentrations (0-, 5-, 10-l m⁻²), and five vegetative conditions (*Sagittaria lancifolia*, *Panicum hemitomon*, *Phragmites australis*, *Alternanthera philoxeroides*, unvegetated control). Under oiling of 5-l m⁻² and 10-l m⁻² (of Louisiana Sweet crude) the short-term response of *Sagittaria lancifolia* was one of increased productivity, whereas *Panicum hemitomon* had the highest biomass production and photosynthetic rates by the end of the experiment. In Contrast, productivity of *Phragmites australis* and *Alternanthera philoxeroides* was severely curtailed in the oiled mesocosms. Overall plant growth, microbial activity, and resultant oil degradation was highest in the mineral substrate, especially when combined with forced substrate aeration and nutrient augmentation. *S. lancifolia* and *P. hemitomon* appear to be excellent candidates for transplants in oiled fresh marshes where local vegetation has been killed and these two species can be expected to significantly enhance microbial degradation of crude oil in said wetlands.

- 236 FORTINO, KENNETH AND ROBERT P. CREED JR. Department of Biology, Appalachian State University Boone, NC – Biotic influences on the distribution and abundance of stream-dwelling crayfish in the New River.

Two species of crayfish (*Orconectes cristavarius* and *Cambarus chasmodactylus*) are common in the South Fork of the New River in NC. *O. cristavarius* is abundant as both adult and young of the year (YOY), while *C. chasmodactylus* are extremely rare as YOY but common as adults. YOY of *C. chasmodactylus* are common in tributaries, however. Laboratory and field experiments were used to determine whether interspecific competition or predation could explain the apparent exclusion of *C. chasmodactylus* YOY from the New River. A target neighbor design was used to test the effect of different *O. cristavarius* densities (0-24/m²) on the growth and mortality of *C. chasmodactylus*. There was no significant effect of increasing *O. cristavarius* density on either the growth or mortality of *C. chasmodactylus*, suggesting that interspecific competition is not responsible for the distribution pattern. A preliminary laboratory experiment was conducted to determine if the YOY of these two species varied in their vulnerability to rock bass (*Ambloplites rupestris*), an abundant fish predator. *C. chasmodactylus* was significantly more vulnerable than *O. cristavarius*. Our results suggest that fish predation may be responsible for the virtual exclusion of *C. chasmodactylus* YOY from the South Fork.

- 237 BROWN, BRYAN L., DOBSON, WILLIAM E. AND CREED, ROBERT P. Dept. of Biology, Appalachian State University, Boone, NC 28608--Distribution, abundance, and symbiotic interactions of an aquatic symbiotic worm on two sympatric species of host crayfish.

Branchiobdellid annelids are symbiotes on freshwater crayfish. It has been stated in the literature that these annelids show no host preference within the local assemblages of freshwater decapods. We performed a survey of Branchiobdellid distribution and abundance on two sympatric species of crayfish in a section of the New River in Watauga County, North Carolina and found a significantly greater Branchiobdellid density on *Cambarus chasmodactylus* when compared to *Orconectes cristavarius*. Regression analysis revealed significant differences in Branchiobdellid density between the two hosts. Choice experiments were also performed in order to determine if the bias in worm abundance results from branchiobdellid preference, host behavior, or combined effects of these two factors. We found that the branchiobdellids actively choose *C. chasmodactylus* over *O. cristavarius* when given the choice between similarly sized individuals. We also tested the assertion that the presence of Branchiobdellids may benefit the host crayfish. To this end we performed growth experiments to determine if the activity of the annelids would influence growth in *C. chasmodactylus*. In conjunction with the growth experiments, we examined gill cleaning as a potential mechanism through which Branchiobdellids may benefit their hosts. The results of these tests show that *Cambarincola* does feed on material trapped in the gill chambers of its host—activity which may lead to improved ventilatory fitness in *C. chasmodactylus*.

- 238 BEARD, CHARLES E. AND PETER H. ADLER. Clemson University - Trichomycete fungi: the unexplored frontier.

Trichomycete fungi are obligate endosymbionts of arthropods. Their most common hosts are aquatic insect larvae, and in many populations they have high infestation rates. They are considered neutral

symbionts, but emerging evidence indicates they might be beneficial or pathogenic to their hosts under some conditions. Trichomycetes have been known for nearly 150 years, and they are common and easy to find, but we have only scratched the surface in our understanding of this group. There are potential host families for which no records yet exist. We have discovered the genera *Harpella*, *Smittium*, and *Stachylina* in Diptera of the family Blephariceridae. Some habitats lack sampling. For example, we have discovered trichomycetes in black flies of the coastal plain and in millipedes of caves. Progress is also being made in understanding the biology and physiology of trichomycetes. We have induced *Harpella melusinae* spores to extrude and attach, the only known case of on-demand extrusion of midgut-colonizing trichomycetes. Zygospores of the genus *Stachylina* have also been induced to form in the laboratory. New species have been described in the literature as recently as 1998. Africa and most oceanic islands are yet to be explored.

- 239 HOCHMAN, E. RACHEL, Department of Biology, University of North Carolina at Chapel Hill, NC 27599-3280 - Impacts of altered river hydrology on regeneration and growth of floodplain trees on the lower Roanoke River, North Carolina: a template for conservation of Southeastern bottomland forests

Given a large river with a managed flow regime (due to flood control, hydropower, etc.) how do we assess: the impacts of managed hydroperiod on regeneration and growth of bottomland hardwood tree species and the amount to which those impacts might be mitigated by altering current release practices at upstream impoundments. The Lower Roanoke River and its floodplain will be used as a model system. This project will develop models of floodplain forest response (in terms of composition and structure) and tree species response (in terms of regeneration and growth rates) to hydroperiod. These models will be linked to the Reservoir Operations Model for the Roanoke River, in order to develop water management strategies that meet forest management and conservation goals as well as economic and social requirements. A protocol for impact assessment, development of conservation goals and implementation of conservation goals will result; this protocol will be applicable to other regulated rivers of the Southeastern United States.

- 240 SMITH, GERALD L.¹, C. CRAIG MORETZ², AND FRED T. YEATS¹. ¹High Point University and ²North Carolina Wild Flower Preservation Society - Spider-lilies of the Atlantic Coastal Plain.

Taxonomic confusion exists in the identification of spider-lilies inhabiting the Atlantic Coastal Plain. Our studies support the recognition of two species and one variety. *Hymenocallis crassifolia* Herb. occurs along the streambanks and floodplains of the outer coastal plain of the Carolinas to northeastern Florida. *Hymenocallis duvalensis* Traub occurs in similar habitats of south central and western Georgia and in interior regions of northern Florida. A third entity, originally described as *Hymenocallis pygmaea* Traub from the Waccamaw River drainage, is considered a narrow-leaved variety of *Hymenocallis crassifolia*. All of these spider-lilies are similar in leaf and floral characteristics but do have distinguishing field characteristics. *Hymenocallis crassifolia* and *H. duvalensis* are also distinguished by different chromosome numbers and karyotypes.

- 241 FLOYD, JENNIFER W. Dept. of Botany North Carolina State University – Phylogenetic analysis of *Gaylussacia* (Ericaceae) using ITS.

The taxonomy of *Gaylussacia*, which is distributed discontinuously in North and South America, has long been disputed. Currently, between 44 and 50 species are recognized; however, many questions still remain as to the phylogenetic relationships of these species and their proper delimitation among the sections of the genus. The Internal Transcribed Spacer (ITS) region of the nuclear ribosomal DNA was sequenced to investigate species relationships in this group of plants. Phylogenetic analyses indicate that the genus may not be monophyletic, as indicated by the closer placement of *G. brachyccera* among *Vaccinium* outgroups. The remainder of the genus contains four distinct lineages that do not completely correspond to the current circumscription of the sections. *Gaylussacia ursina* and *G. baccata* of section *Decamerium* form two separate basal lineages. The *G. frondosa* lineage of section *Decamerium* is sister to section *Gaylussacia*, which contains all of the South American species. Therefore, section *Decamerium* is not monophyletic. In

addition, the sequences for *G. frondosa* and *G. tomentosa* are identical, suggesting the possibility that *G. tomentosa* originated from autopolyploidization of *G. frondosa*. Furthermore, these results do not support the hypothesis that the North American disjunct distribution of the genus arose by 2 or 3 dispersal events from South America. Rather, the North American species appear basal in the phylogeny. A reliable phylogeny and taxonomy for this genus is essential for future studies of the biogeography, character evolution, and biology of the group, as well as any efforts to breed huckleberries for commercial production.

- 242 SMITH, GERALD L.¹, and NANCY C. COILE². ¹High Point University and ²Division of Plant Industry-Florida Department of Agriculture & Consumer Services-Distinctions between *Hymenocallis choctawensis* and *Hymenocallis liriosme*.

Hymenocallis choctawensis Traub has been a poorly understood species until recently. It was described from the western Florida panhandle, and our studies have shown that it ranges from the Apalachicola River drainage to swamp forests of Louisiana. It is distinguished by a rhizomatous bulb, shiny green, oblanceolate, coriaceous leaves, and inflorescences of 2-6 flowers, rarely exceeding 8. The flowers have a funnelliform staminal cup with the margin irregularly bi- or tridentate between each pair of free filaments and are subtended by 2-3 scape bracts with apex acute but not long-tapering. *Hymenocallis choctawensis* has been confused with *Hymenocallis liriosme* (Raf.) Shinnars, but we consider these two species as distinct. *Hymenocallis liriosme* is an early spring-blooming species occurring from western Mobile Bay to eastern Texas in wet ditches, pools, marshes, swamps, and meadows. Its leaves, like those of *H. choctawensis*, are shiny green but are strap-shaped to slightly lanceolate and even more coriaceous. *Hymenocallis liriosme* is also distinguished by asexual reproduction through offsets and by congested inflorescences of up to 14 flowers. The flowers of *H. liriosme* have perianth rays that are not as long-spreading as those of *H. choctawensis*, shorter free filaments, staminal cups whose margins are wavy to coarsely dentate, and 2, decidedly larger, lanceolate scape bracts with long-tapering apex. *Hymenocallis liriosme* and *H. choctawensis* are also distinguished by different chromosome numbers and karyotypes.

- 243 Rebecca R. Bray, Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529-0266-Colonial quillwort--A new species of *Isoetes* from York County, Virginia

Recent field work in the outer coastal plain of Virginia has revealed an interesting and perhaps undescribed species of *Isoetes*. A population of several thousand of these plants occurs along a gently sloping, sandy ephemeral stream bed in a densely forested area in York Co., Virginia. The canopy trees include *Quercus phellos*, *Platanus occidentalis*, *Liriodendron tulipifera* and *Liquidambar styraciflua*. A preliminary examination reveals that megaspores range in diameter from 410-500 μ . Their ornamentation is rugulate, with a spiny-fibrillar secondary texture. Cytological investigation shows the *Isoetes* to be tetraploid, with a $2n$ number of 44. Other tetraploid species in Virginia include *I. acadensis*, *I. appalachiana*, *I. hyemalis*, *I. piedmontana* and *I. virginica*. The present study involves a comparison of the York County plants with the five known and described tetraploid species within the state.

- 244 Musselman, Lytton John¹ and W. Carl Taylor². ¹Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529-0266 and ²Department of Botany, Milwaukee Public Museum, 800 West Wells Street, Milwaukee, WI 53233-1478-A new diploid *Isoetes* from freshwater tidal rivers of Virginia

Recent field work in the Southern United States has revealed a diversity of *Isoetes* taxa including hexaploids, tetraploids and numerous hybrids. We describe a new diploid known to date only from the Chickahominy, Pamunkey, and Mattaponi rivers of Virginia. The quillwort grows in tidal marshes dominated by *Pontederia cordata* and *Nuphar luteum*. Like most quillworts, the tidal river diploid is unremarkable in appearance. Megaspores, however, are distinctive ranging from 240-300 μ in diameter. Ornamentation is rugulate to vermiform on both surfaces with maximum height of features 3 μ . Ridges are low and rounded. Microspores range from 20-30 μ long with echinate ornamentation. Other quillworts found in these marshes and nearby streams include *I. engelmannii* ($2n=22$), *I. acadensis* ($2n=44$), *I. hyemalis* ($2n=44$), and *I. ×cartlaylori* ($2n=33$). Ultimately, an understanding of reticulate evolution in this genus will center on a thorough knowledge of the diploids. This discovery supports the hypothesis that the southern United States is a center of diversity in the genus.

- 245 PITTMAN, ALBERT B. and ANN DARR. South Carolina Heritage Trust Program - A new species of Aster (Compositae) from the sandhills of South Carolina.

Dispersed throughout the Fall Line Sandhills of South Carolina are numerous springs and seeps that give rise to a distinctive assemblage of plants and animals -- some of which are very narrowly distributed endemics. Historically, the sandhill belt has escaped row crop agriculture and urban development and contains the largest contiguous expanse of longleaf pine in the region. The headwaters of these sandhill streams are typically acidic, organically rich, nutrient poor, low in turbidity, and rated "A" in water quality. They are dominated by a unique combination of bottomland hardwood and broadleaf sclerophyllous shrub species known as pocosins. In sharp contrast are the profoundly xeric conditions of the uplands composed of very coarse sands supporting large tracts of longleaf pine/turkey oak communities. Taxonomic study of collections of *Aster* from several stations in this region confirm that a new species endemic to these systems has yet to be described. The most distinctive characters for this *Aster* sp., other than the habitat, are its habit, vegetative morphology, and phenology. In the field one is struck by the long, falcate leaves which drape the decumbent, zigzag-shaped stems and inflorescences, and the large, showy capitula. Across the radial axis of the capitula from distal tip to tip the heads measure ca. 3 cm across. Also distinctive is the habit and phenology -- disk flowers with apparently receptive stigmata and fertile anthers were observed into late November as the branches of the inflorescence lie prone across dense mats of herbaceous vegetation and sometimes just above ground level.

- 246 PERRY, JAMES D. University of North Carolina at Asheville, NC 28804 - Morphology of Sabatia pollen and seed with scanning electron microscopy.

Pollen grains and seeds from all species of *Sabatia* (Gentianaceae) were examined with scanning electron microscopy to determine whether these characters have taxonomic significance. Pollen grains have three meridional colpi which are sunken and generally long with tapering ends. The exine shows a striato-reticulate pattern of sculpturing. Lirae are rounded, more or less parallel, branching and anastomosing at different angles and at different levels. In polar view the grains are rounded-triangular and trilobate. The exine is often conspicuously thickened near colpus margins. In *Sabatia* species there is not a large amount of variation in surface sculpturing of the exine. Species considered to be closely related on other grounds have generally similar pollen morphology. *Sabatia* seed coat morphology proved to be relatively uniform. The majority of cells are widely obovate and slightly to strongly concave; periclinal walls are smooth to slightly or strongly undulate. Wall thickenings include rounded, convex projections which are usually interconnected. Seed coat morphology does not appear to be diagnostic for species of *Sabatia*. Similarities of seed microsculpturing are too close to aid significantly in the systematics of the genus, either for recognition of species or to categorize members of sections or subsections.

- 247 DAVENPORT, L. J. Department of Biology, Samford University, Birmingham, AL 35229 - The Cahaba lily: Endangered species or cultural icon?

Since its discovery at the "cataracts of Augusta" in 1773, the Cahaba lily (*Hymenocallis coronaria*) has been considered to be quite rare. It has been listed as "endangered" by botanists and heritage programs in the three states where it occurs (Alabama, Georgia, and South Carolina), and is currently under review by USFWS as a possible endangered or threatened species at the federal level. In central Alabama, this species assumes added significance as a cultural icon. It symbolizes the unharnessed, unpolluted, free-flowing streams of the state, and is celebrated in poems, photographs, paintings, and sculptures. Its image appears on phone books, wine bottles, and even in the pages of *Playboy*! Since 1990, the small town of West Blocton has held a Cahaba Lily Festival each May, complete with the crowning of a Cahaba Lily Queen and the opportunity to walk among these revered plants.

- 248 KARTESZ, JOHN T. and ROBERT B. COXE. Biota of North America Program, CB#3280 Coker Hall, UNC-Chapel Hill, Chapel Hill, NC 27599 - A Visual Polyclave Computer Key for the North American Flora.

An alternative identification system to dichotomous keys is being developed by the Biota of North America Program of the North Carolina Botanical Garden for the entire vascular flora of North America north of Mexico. The system, here referred to as a visual polyclave, is a computerized identification key, using whole-plant illustrations and accompanying morphology to identify unknown taxa. Using a series of illustrations in concert with a relatively small number of morphological choices, a step-wise elimination quickly narrows the taxonomic possibilities. The identification process provides random access character-state selection, reducing the possibilities that remain via each choice. At any point in the selection process, the user may display a group of species images (representing those species not yet eliminated) and make a tentative identification by matching the unknown plant at hand with one of the images on the computer screen. The selected image could be enlarged, and a full morphological description of that species would also be available. In most cases, with only a few initial choices of geography and easily observable morphology, along with a selection from a display of images, an unequivocal identification can be made.

- 249 RUNDELL, HANNELORE AND MICHAEL WOODS. Department of Biological Sciences, Troy State University -The vascular flora of Ech Lake, Dale County, Alabama.

A survey of the vascular plants of Ech Lake, an area within the Fort Rucker Military Reservation, in Dale County, Alabama, was conducted from April 1997 through March 1999. A diverse assemblage of plant communities were present on the study site. An artificial lake has had an impact on the existing plant communities, and new plant communities associated with the lake have developed. A total of 527 specific and infraspecific taxa representing 284 genera and 90 families were found to occur within the 400 acre study area. Of these, approximately 10 percent were introduced and 7 of the species have been listed as endangered or threatened in Alabama. The Asteraceae represented the largest family with 131 species. Fabaceae and Poaceae were the next largest families with 53 and 41 taxa, respectively. This research was supported by a Blanche E. Dean Floristic Survey Grant from the Alabama Wildflower Society.

- 250 MARCUM, PAUL B. and DAN K. EVANS. Herbarium, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755-Origin of the sterile hybrid *Carex x deamii* F.J. Hermann (Cyperaceae) using Macro and Micro Morphological Characters.

The origin of *Carex x deamii* Herm. has been in question ever since it was first named in 1938. *C. shortiana* is thought to definitely be one parent, but the other parent is not as clear. The other parent has been proposed to be either *C. typhina* Michx. or *C. squarrosa* L. These two species are very closely related and often times very similar in appearance. This study employs macro as well as micro morphological characters to determine which species are the correct parents of the hybrid. Characters include both vegetative and reproductive features. Data was analyzed using SAS and HYWIN (Hypothesizing hybrids using Weighted Intermediacy). Principal Component Analysis (PCA) and Canonical Discriminant Analysis (CDA) were done using the SAS program. PCA showed no clear distinction between *C. typhina* and *C. squarrosa* and was not useful in determining the correct parent. However, CDA showed a clear intermediate relationship between *C. shortiana* and *C. typhina* while *C. squarrosa* separated off by itself. Features of the perigynium and pistillate scales were most useful in separating taxa. HYWIN analysis also showed *C. shortiana* and *C. typhina* to be the most likely parents.

- 251 HUNTER, GREGORY A Dept. Biological Sciences, Marshall University, Huntington, WV 25755. -Herbal medicine of Bill Wyckle, a Southern Appalachian herbalist.

The purpose of this study was to document the herbal medicine of Bill Wyckle, a fourth generation herbalist of the southern Appalachian Mountains. Bill Wyckle acquired his medicinal plant knowledge from the traditions of his family. Macon County, located in the western portion of North Carolina,

encompassed the study site. Bill Wyckle's relatives first came to North Carolina from Germany via Pennsylvania in 1787. Indigestion, headache and diarrhea had the most numerous herbal remedies. Twenty-five species were employed to treat 17 health disorders and two culinary uses. Plant remedies still in use address the minor common ailments and reflect the availability of plant material.

- 252 EVANS, DAN K. Dept. Biological Sciences, Marshall University, Huntington, WV 25755 and Catholic University, Quito, Ecuador. - Medicinal plants of the indigenous Shuar and Achuar people in Southeastern Ecuador.

The Shuar and Achuar people occupy a large portion of southeastern Ecuador. Modern medicine, well established in most rain forest communities, is supplemented by a variety of traditional medicines derived from plants. Surveys of several isolated communities reveal that 34 medical conditions are treated with 81 plant species representing 66 genera and 44 families. The most frequent illnesses of stomach pain, snakebite, and diarrhea are treated with 16, 13, and 7 species, respectively. Plant families with the greatest number of medicinal species are the Asteraceae (8), Solanaceae (7), Fabaceae (5), Araceae (4), and Bignoniaceae (4). The Cyperaceae, with only 3 species, is represented by 11 medicinal plant forms.

- 253 HOGAN, G. RICHARD. Department of Biology, Austin Peay State University, Clarksville, TN 37044 - Inhibition of selenomethionine - induced leukopenia in mice by testosterone.

Selenomethionine (SM) above its micronutrient level has been reported to induce a variety of adverse mammalian effects including those on peripheral blood. It is reported that serial injections of SM promote a marked leukopenia in ICR female mice. Peripheral leukocyte counts (wbc/mm^3) and differential scoring of agranulocytes (Ag) and granulocytes (G) were performed. From these the Ag/G ratios were determined at scheduled intervals between day 1 and day 24 for SM-treated mice and saline-injected controls. Analysis of the ratios revealed that SM treatment caused a striking increase in the Ag/G occurring about day 14. The ratio changes were associated primarily with the number of granulocytes. By day 24 the ratios calculated for experimental mice mimicked those of the controls, which remained at approximately 4.0 throughout the sampling period. When testosterone was administered at times which caused its leukocytosis inducing effect and corresponded to the time of the peak leukopenia caused by SM, the extent of the leukopenia was markedly less. The ratio shift was also reduced. Modes of action are proposed which may account for the SM-induced peripheral leukocyte effect and Ag/G changes.

- 254 PETERSON, JAY A. AND JAY A. YODER. Department of Biology, The Illinois College, Jacksonville, IL 62650 - Investigation on large dermal gland secretions in the lone star tick, *Amblyomma americanum*, as a means to conserve water.

This study addresses a basic question in tick physiology that dates back over 50 years. When ticks are disturbed or exposed to bright light, they secrete a characteristic fluid that covers the tick with a shiny residual outer coat. The putative 'large dermal glands' that release this material are key characters in taxonomic studies. It is widely assumed that this secretion provides a protective barrier to evaporation. Chemically, the secretion consists of *n*- and branched long chain hydrocarbons, the class of lipids well-known to reduce water loss in terrestrial arthropods. In this study, forceps-stimulated lone star ticks, *A. americanum*, had comparable water balance characteristics (net water loss rate, critical transition temperature and activation energies for water loss) as untreated controls. Thus, the secretion has little impact on restricting water movement across the cuticle and plays no apparent role in water balance. This implies that this secretion serves primarily a defensive role (allomonal defense secretion) and promotes tick clustering behavior (aggregation-attachment pheromone; clustering 'alarm' pheromone).

- 255 CROUCH, KELLY C., BENJAMIN W. STEVENS AND JAY A. YODER. Department of Biology, The Illinois College, Jacksonville, IL 62650 - Long distance attraction to a mammalian-derived skin secretion (squalene) by the lone star tick, *Amblyomma americanum*.

Squalene is a potent attractant for the lone star tick, *A. americanum*; attraction is 2-3 fold higher compared to standard attractants benzaldehyde, isobutyric acid, methyl salicylate, nonanoic acid and *o*-nitrophenol -

active ingredients of tick aggregation-attachment pheromones. Because squalene occurs naturally on mammalian skin we can infer that this chemical attracts ticks and facilitates host location. Our study demonstrates that squalene can be detected by *A. americanum* from a distance of $3/4\text{m} < 1\text{h}$ without CO_2 activation, making it especially impressive as an attractant (75% attraction in laboratory and field settings). Responses to components of aggregation-attachment pheromones were considerably less (0-46% attraction). Thus, squalene contributes more to the tick's ability to locate hosts at further distances than the aggregation-attachment pheromones. Negative results obtained with squalene-baited pheromone traps imply that locating hosts is not exclusively linked to squalene. Both CO_2 emitted by the host and aggregation-attachment pheromones play key roles in leading ticks to hosts. We anticipate that the addition of squalene as a supplement to these chemicals in existing baits will enhance the effectiveness of pheromone traps in tick monitoring and eradication programs.

256

BLANK, SARAH M., JEFF D. WEAVER, AND JOHN J. JUST. University of Kentucky-Partial characterization of hatching enzymes from three different Osteichthyes species.

Fathead minnow (*Pimephales promelas*), muskie (*Esox masquinongy*) and walleye (*Stizostedion vitreum*) embryos were mass hatched by exposing embryos to hypoxic conditions. Nearly 40,000 walleye (143 embryos/ml), 12,000 muskie (57 embryos/ml) and 500 fathead minnow (14 embryos/ml) embryos were hatched in three different containers. The hatching media containing the hatching enzyme(s) and digested egg case proteins were collected and frozen at -20°C . Hatching solutions of the fathead minnow, muskie, and walleye, electrophoresed in SDS-PAGE, yielded a minimum of 5, 8 and 14 protein bands respectively. The approximate protein weights (KDa) ranged from 18 to 140 in fathead minnow, 6 to 60 in muskie and 6 to 160 in walleye. A minimum of three proteases was detected in the zymogram electrophoresis of the hatching solution from each of the three species. Protein weights of the proteases detected from fathead minnow and muskie hatching solutions were between 20 KDa and 40 KDa. The estimated molecular weights of the walleye proteases were between 20 and 60 KDa. Protease activity in all three species increased over a 24 hour incubation period and over a temperature range of 14°C to 38°C . The pH optimums of all the proteases were between 6 and 9. Protease activity was retained for a minimum of two years when hatching media was stored at -20°C . Work is in progress to further characterize these proteases.

257

HOOKE, J. BENJAMIN and M. J. SEDIVEC. Appalachian State University. Effects of 1,1,3-tricyano-2-amino-1-propene (Triap) on functional recovery from a crushed sciatic nerve in rats.

These experiments were performed in order to examine the effects of Triap on the functional recovery of rats from a crushed sciatic nerve. The Sciatic Functional Index (SFI) and the Basso, Beattie, Bresnahan (BBB) Locomotor Rating Scale were used to measure functional recovery. A modified pinch test was used to assess sensory recovery. The average SFI of the crush + Triap group was higher than that of the crush only group on the tenth day after surgery. On the eleventh day after surgery, the average BBB score of the crush + Triap group was higher than that of the crush only group. Pinch testing produced an average score of the crush + Triap group which was significantly higher than that of the crush group on the fourth day after surgery ($P = 0.0238$). Pinch test data from the second experiment indicated a significant difference between the experimental (E) and normal (N) sides in the crush + Triap group only on the second day after surgery ($P = 0.024$). These data suggest that Triap may influence events during the first eleven days of the regenerative process, perhaps by up-regulating systems involved in the degradation of damaged nervous tissue or by directly enhancing the regeneration of the damaged nerve.

258

ZETTLER, LAWRENCE W., JENNIFER A. SUNLEY, AND TONYA WILSON DELANEY. Department of Biology, The Illinois College, Jacksonville, IL 62650 - Symbiotic micropropagation of the yellow fringeless-orchid, *Platanthera integra*, from the Green Swamp, North Carolina.

Mycorrhizal fungi are required by orchids to initiate seed germination and to promote seedling development to a leaf-bearing stage. In this study, seeds of *Platanthera integra* (Nuttall) Gray ex Beck, a well-known terrestrial orchid in decline, were collected from the Green Swamp (Brunswick Co., NC), and inoculated with three mycorrhizal fungus isolates (*Epulorhiza* spp.) *in vitro*: UAMH 7633 from *Platanthera ciliaris* in Van Buren Co., TN, UAMH 7809 from *P. integrilabia* in McMinn Co., TN, and Pint-254 from *P. integra* in Brunswick Co., NC. All isolates promoted seed germination, and leaf-bearing seedlings were obtained using the *P. integrilabia* isolate, 432 days after seed sowing. This is one of the few reports of successful symbiotic micropropagation of a North American orchid, and the first report for this species. Evidence suggests that other southeastern orchids (e.g., *Encyclia tampensis*, *Platanthera cristata*, *P. integrilabia*, *Spiranthes cernua*, *S. odorata*) can be propagated *in vitro* using mycorrhizal fungi derived from the root-like organs of unrelated taxa. Clearly, future conservation attempts directed at rescuing an orchid species in decline may hinge upon the continued existence of other unrelated orchids from distant regions.

- 259 STUCKY, JON M. AND DONNA S. WRIGHT. North Carolina State University – *Solidago verna*, a disturbance-adapted, endangered plant species of the Carolinas.

Solidago verna (Asteraceae) is an endangered, flowering plant species of the Carolinas with a primary center of distribution in the Croatan National Forest (CNF) of Craven and Jones Cos., North Carolina. The largest populations occur in the most regularly disturbed sites in the CNF. In individual pine flatwoods, clusters of plants frequently occupy local sites with relatively compacted soil and low vegetative cover and height. Plants produce flowers only after being burned or mowed. In an experimental, field study, seedlings became established in pine flatwood sites that had initially been burned or from which vegetation had initially been removed, but not in undisturbed sites. Considered together, these observations suggest that persistence of populations and founding of new populations are promoted by current forest management practices in the CNF. The current primary threats to *S. verna* are reduction of burning or mowing frequency, plantings of dense grass covers along roadsides following maintenance projects, and total habitat destruction by road and utility construction.

- 260 SOBIERAJ, JAMES H., II AND HOWARD S. NEUFELD. Department of Biology, Appalachian State University, Boone, NC 28608 - Hydraulic architecture of *Galax urceolata*, an evergreen, understory herb of the southern Appalachians.

The ability of a plant species to persist and survive in a forest understory depends in large part on its shade tolerance. However, for shallowly rooted herbs, drought tolerance may also be a factor to contend with, as upper soil layers tend to dry out rapidly between rain events. The objective of this research was to learn more about the water relations of *Galax urceolata* (formerly *G. aphylla*), a shallowly rooted, evergreen, understory herb, and whether changes in hydraulic architecture were related to leaf ageing. We wanted to know if changes in the ability to move water to the leaves was related to the leaf senescence process. Using a Sperry apparatus, we measured hydraulic conductivities for detached first and second year leaves. No differences were found. Next, we measured conductivities of each leaf age class, but this time included the rhizome in the water path, in case changes in conductivity were taking place in this organ, instead of the petioles. Again, we found no differences for the two age classes. We then investigated whether ageing changed the susceptibility of the petioles to cavitation. Using two different methods for introducing embolisms into the xylem, centrifugation and air injection, we found no difference in susceptibility to cavitation between leaf age classes. Cavitation did not begin until leaf water potentials reached -2.2 MPa, and conductivities were still 50% of maximum at -4.0 MPa. Previous research has shown that in the field, water potentials in *Galax* rarely decrease below -1.6 MPa, thus this species would rarely, if ever, suffer embolisms under typical field conditions. The failure to find any differences in hydraulic conductivity between the leaf ages suggest other processes are at work here, probably hormonal in nature.

- 261 ULREY, CHRISTOPHER J. AND THOMAS R. WENTWORTH. Dept. Botany, North Carolina State University, Raleigh, NC 27695-7612 - Evaluation of ordination procedures using field and simulated data: analysis of the Thompson River data.

Procedures for indirect gradient analysis (referred to as ordination procedures) are widely used to extract the principal dimensions of compositional variation from highly-dimensional data gathered

during the study of ecological communities. Evaluations of the efficacy of these procedures have generally relied on comparisons of outcomes when various procedures are applied to community data (arrays of species x sampling units, with presence/abundance data as elements). The data used in such evaluations are either derived directly from field studies or are produced by simulation. Evaluations with simulated data are preferred because the underlying structure of these data is known. However, simulated data may not faithfully recreate structure inherent in field data. To address this problem, we produced simulated data that have characteristics (such as alpha and beta diversity, or frequency/abundance patterns) paralleling those in field data. We illustrate this process using field data from a study of vegetation in the Thompson River Watershed in the Southern Appalachians. Both the field and simulated data were subjected to two popular ordination procedures (Detrended Correspondence Analysis and Non-metric MultiDimensional Scaling) in an effort to evaluate the efficacy of these two procedures.

262 HUDSON, JARVIS E. Fayetteville State University - Twenty-three years of change in an oak-dominated forest.

In order to observe population dynamics of trees and to record changes in tree species composition in a second-growth oak-dominated forest in eastern Kentucky, density of tree seedlings was monitored from 1975 to 1989, density of saplings was monitored from 1975 to 1997 and density and basal area of canopy trees were measured at intervals between 1977 and 1998. Density of seedlings varied between 18,140/ha in 1977 and 29,880/ha in 1989, density of saplings declined from 9000/ha in 1977 to 3460/ha in 1997, and density of canopy trees declined from 672/ha in 1977 to 527/ha in 1991 and rose back to 556/ha by 1998. Relative density of *Nyssa sylvatica* saplings decreased from 49% in 1977 to 24.9% in 1997. Relative density of *Oxydendrum arboreum* saplings varied from 12.8% in 1976 to 6.4% in 1989 and for *Acer rubrum* saplings it varied from 11.9% in 1975 to 28.3% in 1997. From 1977 to 1998 among the 13 species represented by canopy trees relative density declined from 46.1% to 27.3% for *Quercus coccinea* and from 3.4% to 0.5% for *Pinus rigida*. Relative density of *Quercus prinus* in the canopy varied between 40.1% in 1977 and 51.9% in 1988 and relative density of *Acer rubrum* increased from 1.5% in 1977 to 14.5% in 1998. Species diversity (H') of seedlings varied from 1.962 in 1975 to 1.390 in 1989. H' for saplings varied from 1.697 in 1977 to 2.042 in 1997 and for canopy trees it increased from 1.278 in 1977 to 1.473 in 1998. Evidence suggests that in the absence of fire or other major disturbances *Quercus coccinea* will continue to decrease and *Quercus prinus* and *Acer rubrum* will continue to increase.

263 ULREY, CHRISTOPHER J.¹, THOMAS R. WENTWORTH¹, AND PETER R. MINCHIN². ¹Dept. Botany, North Carolina State University, Raleigh, NC 27695-7612 and ²Dept. Biological Sciences, Louisiana State University, Baton Rouge, LA 70803 - A comparison of Detrended Correspondence Analysis and Non-metric MultiDimensional Scaling using vegetation data from the Southern Appalachians.

The relative efficacy of two ordination procedures, Detrended Correspondence Analysis (DCA) and Non-metric MultiDimensional Scaling (NMDS), was evaluated using both field data from three landscapes in the Southern Appalachians and simulated data. The three field datasets used were: Thompson River Watershed, Black and Craggy Mountains, and Northern Red Oak Community. While the two ordination procedures using field data often yielded strikingly different results, we were unable to assign superiority to either procedure because the underlying structure of the data was unknown. Using simulated data, we were able to determine which ordination procedure came closest to capturing the known structure of these data. Desiring a measure of realism, we generated simulated data with properties that closely resembled those of the field data. We also explored the effects of three types of data transformation on ordination results. We present detailed findings from analyses conducted on vegetation data collected by Dr. Don McLeod in the Black and Craggy Mountains and summarize comparative results for all three datasets. The approach of using both field data and simulated data in conjunction with multiple datasets allows for a meaningful comparison and evaluation of ordination procedures.

264 WALLY, ALAA L. Ecology Curriculum, University of North Carolina, Chapel Hill NC 27599 - Effects of canopy on viability in a population of the federally endangered pitcher plant *Sarracenia jonesii*.

Sarracenia jonesii is a rhizomatous insectivorous perennial reduced to eleven populations in mountain bogs and rock outcrop water-slides of the western Carolinas. Monitoring has indicated the species has very poor recruitment from seed in the North Carolina bog sites. Little is known about the ecology of *S. jonesii* or that of the rare and isolated communities to which they are native. Succession to woody cover, perhaps facilitated by anthropogenic influences on nutrient and hydrology dynamics, is occurring at several sites and may be disrupting the reproductive ecology of *S. jonesii* populations in North Carolina. Seed production and quality as measured by seed number, seed weight, seed shape and color, capsule color, fungal infection, and seed viability were evaluated at one such site in 1996 and 1997. Viability was found to be significantly lower under canopy. The mechanism of inhibition is likely humidity relations at the scale of the individual capsule and warrants further study. Results indicate canopy management will improve propagule quality at this site. This project is a part of a larger study investigating reproductive limitations within this population.

- 265 WHITE, RICKIE D. University of North Carolina at Chapel Hill – The impact of Hurricane Fran on the vegetation of a North Carolina Piedmont woodland.

The response to Hurricane Fran of the canopy and understory of the forest at the North Carolina Botanical Garden was studied to examine the effects of the storm. Canopy trees and understory herbs, shrubs, and seedlings were all significantly different after the event as compared to before. The canopy of the forest showed changes and trends such as the resistance of *Quercus alba* and *Acer rubrum* and the lack of resistance of *Quercus rubra* to wind damage. In addition, herb cover increased in response to gaps and tip-ups formed by the wind event. Shrub cover remained the same. Early successional seedlings such as *Liriodendron tulipifera* and *Pinus* species increased, while *Quercus* species did not reproduce widely. Exotic species which were not found before the hurricane in the plots, such as *Ailanthus altissima* and *Paulownia tomentosa*, increased over the landscape. These changes in the canopy and understory of the forest show both the quick response of the vegetation to hurricane damage and the severe ecosystem change which may occur due to such large wind events.

- 266 COLLINS, BEVERLY AND LORETTA BATTAGLIA. Savannah River Ecology Lab and Louisiana State University - Microenvironmental heterogeneity and *Quercus michauxii* seedling growth in experimental canopy gaps.

Canopy gaps are foci for forest regeneration; enhanced light in gaps promotes tree growth into the canopy. In bottomland hardwood forests, however, microtopography may primarily determine tree seedling establishment. We tested effects of canopy openness and pit-and-mound microtopography on germination and early growth of a moderately shade tolerant species, *Quercus michauxii* in experimental gaps in a bottomland hardwood forest on the Savannah River Site near Aiken, SC. Acorns were planted on pit and mound complexes created in the center, at the edge, and under forest canopy surrounding 40 m radius gaps. In addition, acorns were planted at 42 random locations in and around each of two replicate 7, 14, 20, 29, and 40 m radius gaps. Germination was higher on mounds than in pits at all gap positions; no acorns germinated in pits in the gap center. Seedling survival was higher on mounds than in pits, and was greatest at the forest edge. Seedling growth was greater on mounds than in pits, especially on gap center mounds. Over all gaps, 52 % of the randomly located acorns germinated and survived one year. First-year height growth did not differ among gaps or gap sizes. Growth was related to distance from gap center in both 10 m gaps, in one 29 m gap, and in one 40 m gap; growth decreased with distance from gap center. Positive (+,+) interactions between canopy openness and mounds appear to facilitate *Q. michauxii* regeneration in this forest.

- 267 BROWN, REBECCA L. Ecology Curriculum, University of North Carolina, Chapel Hill, NC 27599-3275 - Species richness of native and exotic plants in southern Appalachian riparian zones.

Species richness values of native and exotic plants of riparian and upland areas in the southern Appalachians were compared using 47 riparian plots and 528 upland plots from the North Carolina Vegetation Survey dataset. Species richness and exotic plant invasion were found to be significantly greater in riparian areas than in upland areas. I propose that the richness of native and exotic plants can be explained by the high propagule influx and frequent disturbance that characterize southern Appalachian riparian zones, and I present a theoretical framework that relates aspects of plant community structure to propagule influx.

- 268 DILUSTRO, JOHN J. and FRANK P. DAY. Old Dominion University, Norfolk, VA 23529 – Fine root growth and demographic responses to elevated carbon dioxide in an oak-palmetto scrub ecosystem.

Measurement of root growth response to elevated atmospheric carbon dioxide is critical to understanding soil carbon input. We investigated the effects of elevated carbon dioxide on fine root growth using open top chambers with both ambient and elevated (700 ppm) CO₂ treatments in an oak-palmetto scrub ecosystem at Kennedy Space Center, Florida. Minirhizotron tubes were installed in each elevated and control chamber to allow observation of plant roots. Each tube is sampled every three months. Results to date show an increase in root length density (RLD) in the top 101-cm of soil. Initial measurements taken in March 1996 were 2.22 mm cm⁻² for the enriched chambers and 2.41 mm cm⁻² for the control chambers. Carbon dioxide enrichment of the plots began May 15, 1996. The enriched plots showed a higher root length density (4.42 mm cm⁻²) than the control plots (3.62 mm cm⁻²) by the December 1997 sampling. Results up to December 1997 suggest enhanced root proliferation at greater depth, with root length density 65 % greater in the enriched plots than the ambient plots for the 75-101 cm depth interval. We have observed increased root growth during periods in which other researchers involved in the same project have observed increased photosynthesis but not increased aboveground biomass.

- 269 ASOMANI, KWAME AND RICHARD M. DUFFIELD Dept. Biology, Howard University, Washington, D.C. 20059 - Macroinvertebrate populations of treeholes in Fort Foote Park, Prince George's County, Maryland.

The contents of forty-seven treeholes were collected from Fort Foote Park, Prince Georges County, Maryland between March and August, 1998. Treeholes were located by surveying the landscape on foot. Samples were collected by removing the liquid and leaf litter contents. Sample volumes ranged from approximately 125 to 250mL. Each sample was placed in its own plastic container and taken to the laboratory where the immature organisms were reared to their adult stages. Rearing containers were checked three times weekly. Of the treeholes sampled, 38 were pans and 9 were rot holes. Of these 7 were collected from oak (*Quercus* spp.), 24 from maple (*Acer* spp.), 8 American beech (*Fagus grandifolia*), 4 from American elm (*Ulmus americana*), and 4 from magnolia (*Magnolia* spp.). Of the treeholes sampled, 40 contained mosquito (Culicidae) larvae, 7 contained no insect larvae and one contained 2 syrphid (Syrphidae) larvae. The total number of mosquito adults collected was 357, and the greatest number of mosquito adults recovered was 56. Of the 40 samples containing mosquitoes, the average number of mosquitoes sampled was 8.9. One third of the treeholes contained 4-6 mosquito larvae. The dominant mosquito was *Aedes triseriatus* (Say), the eastern treehole mosquito. Partially sponsored by the USDA-Forest Service (Eastern Region) and Howard University.

- 270 TAYLOR, DAVID D¹. AND DEBORAH L. WHITE². ¹USDA Forest Service, Winchester, KY 40391 and ²Kentucky State Nature Preserves Commission, Frankfort, KY 40601 - Status of the threatened plant, *Solidago albopilosa*: population trends, threats and opportunities.

Most populations of this endemic goldenrod are found on the Daniel Boone National Forest in east-central Kentucky; the remaining populations are on several private tracts. All populations are found in the Red River Gorge Geological Area, an important recreational destination for about one million visitors per year. The goldenrod grows on sandstone cliffs and in rock houses at the base of the cliff, locations which provide numerous recreational opportunities. A monitoring plan was developed and implemented in 1996 to provide both quantitative and qualitative data for assessing the impacts of recreational activities on the goldenrod and its habitat. The data collected suggest the total population is currently stable, but may have declined from late 1970s-early 1980s levels. Many populations appear stable to increasing and secure; others are either threatened by or are experiencing damage from recreational activities. A series of activities designed to eliminate damage and reduce threats have been developed in consultation with U.S. Fish and Wildlife Service.

- 271 SPENCE, CRYSTALL AND SCOTT B. FRANKLIN. Department of Biology, University of Memphis – Classification and ordination of forest stands in Natchez Trace State Forest, TN.

A nation-wide effort of Gap Analysis is currently in progress to produce an inventory of each State's biological resources. The Gap analysis approach was used to obtain a field inventory of the major biological

elements in Natchez Trace State Forest. Natchez Trace State Forest contains 15,000 ha of steep to gently sloping dissected uplands within the Upper Gulf Coastal Plain physiographic province, with the center located at 35°60' N latitude and 88°15' W Longitude, about 40 miles Northeast of Jackson, TN. 61 circular 0.04 ha plots marked with a permanent stake were located within seven major site types: ridgetop, bottomland, terrace, northeast facing/sand parental material, southwest facing/sand parent material, northeast facing/clay parent material and southwest facing/clay parent material. All stems >9 cm at breast height (DBH) were measured and identified to the species level. All stems 1.0 – 9.0 cm dbh were counted and identified to the species level as saplings. The resulting data was analyzed with group average cluster analysis and nonmetric multidimensional scaling. The data analysis found a typical central hardwood forest xeric to mesic gradient of 10 identifiable groups, with the middle of the gradient being unclear due to past disturbances to the system.

- 272 GEISSINGER, KAREN E., HOWARD S. NEUFELD AND ROBERT SUTTER¹. Department of Biology, Appalachian State University, Boone, NC, ¹The Nature Conservancy, Chapel Hill, NC - Grazing influences on plants in a southern Appalachian mountain bog.

The effects of grazing have been well-studied on rangelands in the western United States. However, much less is known about the ecological impacts of grazing in eastern grasslands and wetlands. Along the Blue Ridge Parkway (BRP) in NC and TN, there are more than 600 rare plants and animals, yet few of these lands are fully protected. For example, in 1996, there were 370 agricultural leases with grazing permitted, on 3,500 acres of BRP lands, some of them wetlands. Mountain wetlands are the rarest, and least protected ecosystem in the southern Appalachians, and particularly important refugia for rare and endemic species. This study is designed to test the hypothesis that grazing by cows affects net primary productivity (NPP) and species diversity in wetland bogs. Grazing may stimulate productivity by removing older, less efficient tissues, recycling nutrients from dung and urine, and increasing available light to younger, more active leaves. Field work will consist of comparing NPP and species diversity between grazed and ungrazed sites in Cold Prong Bog on the BRP. Baseline data collected in the summer of 1998 (before grazing was eliminated) showed the bog dominated by sedges, rushes, grasses and forbs, with isolated stands of woody plants. A portion of the bog is being fenced off now and will constitute our treatment site. In addition, we will be conducting greenhouse experiments on the effects of grazing on an annual, introduced grass, *Holcus lanatus* and a native, perennial sedge, *Carex lurida*, in order to determine how these species respond to grazing, and how they might affect successional patterns in the portion of the bog freed from grazing. We predict that woody plant cover will increase, and shade tolerant species will become more prevalent over the years.

- 273 SEMLER, BROOKE A. and A. JOSEPH POLLARD. Department of Biology, Furman University, Greenville SC 29613 - Colonization of a man-made pond by bunched arrowhead, *Sagittaria fasciculata*, with observations on possible dispersal by muskrats.

Sagittaria fasciculata, or bunched arrowhead, is a globally endangered plant which grows only in Greenville County, SC and adjacent Henderson County, NC. One of the five known populations of this species occurs on the campus of Furman University, in a shallow wetland formed by a small permanent stream. In early 1991, a small pond was dug approximately 100m uphill from the *Sagittaria* site. The pond is fed by rainwater and an ephemeral stream, and drains into the wetland below. In 1998, we observed that *S. fasciculata* plants have colonized the pond in large numbers and flower profusely. This is the only report of which we are aware in which this species has spontaneously expanded its distribution, especially into anthropogenic habitats. Plant size in the pond is dependent on water depth; in shallow water around the pond margin, leaf lengths were approximately 15cm, but in deeper water individuals well over 30cm tall were observed. The mechanism responsible for dispersal in an uphill direction is of great interest, especially in light of reports that seed set is extremely low in this species. The pond has a resident population of muskrat (*Ondatra zibethica*), and we have observed these animals feeding on the shoot bases of *S. fasciculata* plants. Feeding behavior involves uprooting of intact shoots and transportation of shoots to the den area on the pond bank. Thus, we speculate that muskrat herbivory may be a significant dispersal factor for this rare species, as well as a potential threat to it.

- 274 AUGENFELD, KIMBERLY AND SCOTT B. FRANKLIN. University of Memphis, Memphis, TN 38152 – Over a decade of change in a natural shortleaf pine community at Land Between the Lakes.

A unique community of shortleaf pine (*Pinus echinata*) was found to have few shortleaf pine seedlings and saplings in the understory in 1986-7 at Land Between the Lakes, Stewart County, Tennessee. The

shortleaf pine community is unique based on location, separate from most of the range and age, between 70-135 years old. Two different studies suggested a strong successional trend toward oak (*Quercus*) domination. Suggestions were made for the regeneration of pine management in this State Natural Area as a result of the two snap-shot data sets. These plots (n=41) were resampled in 1998-9 to examine over a decade of forest community composition changes. Basal area of overstory stems (>9cm) and density of younger stems (>3cm) were compared between the past and present sampling. No significant differences were found between the sampling and a research design exploring metapopulation dynamics facilitated for management and conservation of the shortleaf pine community will be presented.

- 275 MCLEOD, KENNETH W. Savannah River Ecology Laboratory, University of Georgia, Aiken, SC 29802
- Reforestation of severely disturbed bottomland forest sites.

Fourmile Branch is a third order tributary of the Savannah River on the upper coastal plain of South Carolina which received thermal effluent from a nuclear production reactor from 1955 to 1985. Over the three decades, the thermal effluent destroyed about 100 ha of bottomland forest in the stream corridor and delta where this stream enters the swamp associated with the Savannah River. The effluent virtually sterilized the stream: the former vegetation could not resprout and a viable woody seedbank did not exist in the sediment. Once the effluents ceased, the initial natural recovery was dominated by early successional wind-dispersed weedy species, such as loblolly pine, black willow and other weeds common to early succession of abandoned agricultural fields. These species still dominate the stream delta. To accelerate natural succession a reforestation program began in 1990 and has explored the site suitability of 24 woody species and the effectiveness of various silvicultural techniques in establishment of transplanted tree stock. In summary, to maximize the probability of successful reforestation, use woody species that are more flood-tolerant than initially felt necessary. Flood-tolerant species are more likely to survive if the site is drier than anticipated than dry site species can survive being inundated. Bareroot seedlings of these species, protected with ≥ 1 m tall tree shelters, will have adequate survival and height growth. Control of the existing herbaceous/grass ground cover or removal of a willow canopy did not improve establishment of the transplants, nor did use of large tree stock or soil fertilization.

- 276 CLARIDGE, KEVIN AND SCOTT B. FRANKLIN. University of Memphis,
Memphis, TN 38152 - Potential Effects of an Exotic Invasive Plant on Erosion, Soil Nutrients, and Aquatic Primary Production.

A comparison of erosion, soil nutrients, and aquatic primary production was conducted on two sites at the Meeman Biological Station in Memphis, TN, before and after the removal of Kudzu (*Pueraria montana* (Lour.) Merr. var. *lobata* (Willd.) Maesen & Almeida). Kudzu is an exotic invasive vine that can dominate an area with its vigorous growth. Kudzu Pond, a pond surrounded by Kudzu, was used as the test pond and Payne's Pond was used as the control. Kudzu Pond should have a higher algal production than Payne's Pond because of the increase in nitrogen created by the leguminous Kudzu. A monospecific stand of Kudzu was removed by spraying the Kudzu around Kudzu Pond with the herbicide Transline. Sediment transported on the slope surrounding the pond, alterations of soil nutrients, and changes in algal production were examined after the Kudzu was eliminated. This study examines the potential effects of an exotic invasive species on an ecosystem at various levels and explores the idea that the effects of an exotic species can cross ecosystem boundaries.

- 277 KNEBEL, LARISSA, AARON COOPER AND J. DAN PITILLO. Western Carolina
University - Changes in old growth hemlock (*Tsuga canadensis*) forests in the
Cataloochee watershed of the Great Smoky Mountains National Park.

In the 1930's, Frank H. Miller and crews carried out a survey of the then proposed Great Smoky Mountains National Park as part of an effort to develop a vegetation map. The Cataloochee watershed, located in the northeastern portion of the park, contains some of the last remaining stands of old growth *Tsuga canadensis* forests. This study attempts to classify this forest type and to compare present day forests with those of the 1930's. Twenty *Tsuga canadensis* plots that were originally sampled by Miller's crews were resampled for this study. The results show that the majority of the forests that were categorized as hemlock types in the 1930's have shown changes

in overstory species richness, basal area and density. An additional 26 plots were surveyed in order to provide more information about *Tsuga canadensis* community associations in preparation for the arrival of the hemlock woolly adelgid (*Adelges tsugae*).

JOLLS, CLAUDIA L.^{1,2} AND JON D. SELLERS¹. ¹East Carolina University, Greenville, NC 27858-4353 and ²University of Michigan Biological Station, Pellston, MI 49769 - Rare plant reproductive ecology and GIS applications to conservation of the Great Lakes dune ecosystem

The Great Lakes Basin houses 131 globally unique species, communities and habitats. Since 1993, we have studied the population biology of three rare Asteraceae and their conservation: Pitcher's thistle (*Cirsium pitcheri*), Houghton's goldenrod (*Solidago houghtonii*) and Lake Huron tansy (*Tanacetum huronense*). These sympatric taxa have distinct microsites, life histories and population dynamics. Pitcher's thistle is monocarpic, lacks vegetative reproduction, is outcrossed by insects, has moderate seed set and produces achenes dormant at dispersal. Seeds require aging or chilling to break dormancy. Plants occur along dynamic shorelines, dunes and blow outs. Houghton's goldenrod has limited vegetative reproduction, requires insects for relatively low seed set and has germination requisites similar to the thistle. In contrast, Houghton's goldenrod is confined to wet cobble shores and interdunal swales, and tolerates limited burial. Lake Huron tansy is clonal with high seed output; our data suggest autogamy. Like Pitcher's thistle, this tansy is adapted to burial and germination appears light-inhibited. We used 1978-1985 land cover types from the Michigan Resource Information System (MIRIS) to evaluate habitat suitability for these taxa. Cover types were derived from 1:24,000 scale sources. Although Michigan leads the nation in freshwater shoreline (7500 km), fewer than 110,000 ha of dunes exist. "Even within a three county shoreline length of 160 km, less than 25% was suitable habitat. Dunes are infrequent in geological time and dynamic in ecological time; their biota is imperiled by anthropogenic habitat destruction. Geo-referenced ecological data can help identify areas at risk and others suitable for restoration.

278

ESTEP, BRET AND L. S. BARDEN. Biology Department, University of North Carolina at Charlotte, Charlotte, NC 28223 - Ecotypic variation in Schweinitz's sunflower *Helianthus schweinitzii*: Implications for endangered species management.

Ecotypic variation between two populations of the Federally listed endangered perennial sunflower *Helianthus schweinitzii*, growing on markedly different soil types and separated by 50 km, was examined using reciprocal seed transplants. At the native site of each population in the Piedmont of NC, USA, 50 paired plots were established in fall 1996 and planted with seed from each of the two populations. Life history characters including survivorship, plant height, and flower number were measured for two years. Split-plot two-factor ANOVA revealed no significant interaction between seed source and site, suggesting the absence of local adaptations in the two populations. However, during both years and at both sites, plants from one site were significantly taller than plants from the other site, suggesting a difference in either maternal effects or genetic traits between the two populations. The lack of significant interaction between source and site, coupled with similarly negative findings of an allozyme study, would normally be sufficient evidence to conclude that genetic concerns about transplanting this endangered species are unwarranted. However, the taller growth of plants from one population, which was observed at both sites, suggests delaying interpopulational transplants until further experiments distinguish between maternal and genetic causes for the height difference.

279 METTLER, PAIGE A.¹, MARIAN SMITH² AND KELLY VICTORY². ¹Dept. Plant Biology, Southern Illinois University, Carbondale, IL 62901 and ²Southern Illinois University, Edwardsville, IL 62026 - Alternative disturbance regimes for the threatened floodplain species, *Boltonia decurrens*.

Boltonia decurrens (Asteraceae) or decurrent false aster, is a fugitive floodplain species that colonizes disturbed sites along the Illinois and Mississippi Rivers. The natural river systems have been replaced by a series of levees, locks and dams, altering their dynamic nature and therefore affecting timing, frequency and duration of flooding. The replacement of the natural river system with an artificially controlled one is partially responsible for the endangered status of this species by limiting and changing disturbance events within the river ecosystem. Unless there are subsequent disturbance events, *B. decurrens* is replaced by competing vegetation within three to five years. In an effort to prevent extinction of this species, a study was initiated to assess the effects of burning and mowing on the seed bank and vegetative composition of the population

located at Woodford County Conservation Area, Illinois. This population was divided into 3 treatments: a control, a mow and a burn. Vegetation analysis was conducted in 1995, 1996 and 1997. Vegetation was identified and counted monthly along transects established in each treatment. Diversity (calculated using the Shannon-Weiner Index) and richness declined in all treatment areas. The *B. decurrens* populations also declined by >90%, indicating that burning and mowing do not promote population regeneration for the species.

- 280 ALLEN, BRUCE P., ERIC F. PAULEY, and REBECCA R. SHARITZ. Savannah River Ecology Laboratory and Coastal Carolina University – Vegetation dynamics and response to disturbance in a southeastern floodplain forest.

Vegetation dynamics following hurricanes are influenced by the nature and extent of wind damage. In 1989, Hurricane Hugo struck the old-growth floodplain forests of the Congaree Swamp National Monument causing extensive but patchy damage to the canopy dominants. Hurricane impacts on forest composition and growth were monitored in ten 1-ha permanent plots established in 1990 and re-sampled in 1994 and 1998. The extent of forest damage varied by forest type; slough and seep forests suffered minimal damage while bottomland hardwoods suffered much higher levels of tree damage. Within bottomland hardwoods, heavily damaged areas had high mortality rates for the canopy dominants and associated lianas. Recruitment into the sapling size class (2.5 cm) has continued to increase over eight years. New stems have been dominated by subcanopy species but included potential canopy species. The current canopy dominants, *Liquidambar styraciflua* and *Quercus* spp., have been recruited only in heavily damaged areas. In less damaged bottomland hardwood, seep, and slough communities, hurricane influences were limited to small reductions in basal area and the recruitment of shade tolerant subcanopy and liana species. Hurricane Hugo's impact on canopy and understory species composition was most dramatic in heavily damaged stands.

- 281 TIMOTHY W. SAVIDGE AND DALE W. SUITER. Planning and Environmental Branch, North Carolina Department of Transportation, Raleigh, NC 27611 – The North Carolina Department of Transportation's methods to offset impacts to the federally Threatened *Hexastylis naniflora*.

Hexastylis naniflora is currently listed as a Threatened species by the U.S. Fish and Wildlife Service. In North Carolina, this species is found in the western Piedmont physiographic province. Increasing development pressures of this region have resulted in a number of new transportation projects within the species' range. North Carolina Department of Transportation biologists have discovered 11 previously unknown populations of this species while conducting environmental studies for these transportation projects. These new discoveries have resulted in a better understanding of the species' status, including an expansion of the known range. Many of these new populations are substantial in size and one is currently the largest one known. Some projects have resulted in unavoidable population impacts. Measures taken to offset these impacts have included transplantation to protected sites and habitat purchase/protection of significant populations. These protection efforts have helped the recovery efforts to the point that de-listing is being considered.

- 282 SUITER, DALE W. AND TIMOTHY W. SAVIDGE. Planning and Environmental Branch, North Carolina Department of Transportation, Raleigh, NC 27611 – The North Carolina Department of Transportation's management of roadside populations of rare plant species.

In North Carolina, rare species such as *Echinacea laevigata*, *Helianthus schweinitzii*, *Rhus michauxii*, *Lysimachia asperulaefolia* and *Thalictrum cooleyi* often occur along roadsides and in power line rights of way. These species occur naturally in communities that were once dominated by fire. Due to human intervention, fire is no longer a regular part of these ecosystems. Now, roadsides and power lines that are regularly maintained by mowing mimic fire maintained ecosystems. The North Carolina Department of Transportation (NCDOT) currently protects over 35 populations of rare plants growing along its roadsides. Most of these plants are listed as federally threatened or endangered by the U.S. Fish and Wildlife Service (USFWS) while others are listed as rare by the North Carolina Natural Heritage Program (NCNHP). The NCDOT works with the USFWS, the NCNHP and the North Carolina Plant Conservation Program as well as various public utilities to protect these roadside populations of rare species. Rare plant populations are marked with white-topped wooden stakes and "Do Not Mow" signs, an indication to mowers that the area is off limits during the growing

season. These areas are managed on a site by site basis according to their individual needs. Management strategies to control invasive woody vegetation include mowing during the dormant season, hand pruning and prescribed burning. The NCDOT is currently revising its guidelines to better protect these rare plant populations.

- 283 BAUCOM, REGINA, JAMES ESTILL, AND MITCH CRUZAN. University of Tennessee, Knoxville -The effect of corporate logging on genetic diversity of *Acer saccharum*.

In this study we compared the genetic diversity between populations of *Acer saccharum* that were directly effected by corporate logging to stands that are virgin. From previous research on land use history we were able to determine which areas of the Great Smoky Mountains National Park were corporate logged and which areas were virgin. A hand-held GPS device was used to identify populations that were located within these previously determined boundaries. We sampled 12 corporate logged and 10 virgin stands by collecting leaf samples from forty individuals along a 20 meter wide transect. After characterizing the general ecology of the plot, we recorded DBH, transect position and pathogen information for each individual. We chose to measure genetic diversity indices by starch gel electrophoresis due to the large amount of literature for this specific technique with *Acer saccharum*.

- 284 TYNDALL, R. WAYNE. Maryland Department of Natural Resources, P.O. Box 68, Wye Mills, MD 21679 - Vegetation change in a Carolina Bay in Maryland over an 11-year period.

Herbaceous zones in a Carolina bay in Maryland (Delmarva Bay) were monitored annually during 1987-1997 by sampling peak percent cover of each species in permanent plots and by fixed-point photography. The *Panicum hemitomon* Schult. zone of 1987 became dominated by *Acer rubrum* L. (red maple) and *Liquidambar styraciflua* L. (sweet gum). *Panicum hemitomon* cover decreased from 80% to 1%, and *Rhexia virginica* L. disappeared from the plots. Since the *P. hemitomon* population did not expand toward the center of the bay, this zone is expected to be succeeded by a forested zone of *A. rubrum* and *L. styraciflua*. Likewise, the *Rhynchospora charalocephala* zone was overtaken by *A. rubrum* and *L. styraciflua*; *Rhexia virginica* all but disappeared from the zone; and this zone also is expected to become forested. The central zone was dominated by *Scleria reticularis* Michx., *Rhexia virginica*, *Lachnanthes caroliniana* (Lam.) Dandy, and *Panicum verrucosum* Muhl. throughout the study period. Although the relative cover of these species changed from year to year, a significant trend in percent cover did not occur over the 11-year period indicating a stable or slowly changing zone. However, in ecotone plots of the central zone and the *P. hemitomon* zone, *R. virginica* decreased significantly and red maple and sweet gum increased significantly indicating that woody plant succession will also effect the central zone.

- 285 POLLARD, A. JOSEPH, C. BRANNON ANDERSEN, and SANDRA K. WHEELER. Departments of Biology, Earth and Environmental Science, and Chemistry, Furman University, Greenville SC 29613 - Biogeochemistry of trace metals at the Chunky Gal mafic/ultramafic site, North Carolina.

The Chunky Gal mafic-ultramafic complex in the Nantahala National Forest of western North Carolina consists of dunite and amphibolite folded into a paragneiss, and is well studied from a purely geologic view. The presence of three rock types with contrasting chemical and physical properties within a 3 km² area offers an excellent opportunity to study the effect of geochemistry on plant ecology and the effects of vegetation on ecosystem chemistry. From each lithology, we analyzed rock - soil pairs using X-ray fluorescence (XRF) spectrometry. The chemistry of waters draining each site was analyzed using inductively coupled plasma (ICP) spectrometry. Samples of the four most common woody plant species on each site were ashed, dissolved in nitric acid, and analyzed using ICP spectrometry. As expected, the ultramafic dunites showed elevated concentrations of Cr, Co, Ni, and Mg, and low concentrations of Ca, K, and P. Mafic amphibolites had elemental concentrations intermediate between those of dunite and felsic gneiss. Plants did not accumulate measurable amounts of Cr or Co. Mg/Ca ratios in vegetation paralleled those in rocks and soils. Ni accumulation in plants also reflected geological concentrations; however, deciduous trees had noticeably higher Ni uptake than did evergreen species. Plant community differences between dunite and other lithologies may relate to Ni or Mg toxicity, Ca, K, or P deficiency, physical characteristics such as soil thickness and drainage, or a combination of these factors.

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In This Issue

PROGRAM of the 60th ANNUAL MEETING of the ASSOCIATION OF SOUTHEASTERN BIOLOGISTS	31
ASB CANDIDATES FOR OFFICE	32
GENERAL INFORMATION	39
PLENARY SPEAKER	43
PROGRAM SUMMARY	45
CALL FOR NOMINATIONS FOR EDITOR OF THE ASB BULLETIN	49
ASB PAPER AND POSTER SESSIONS	50
BETA BETA BETA BIOLOGICAL SOCIETY	89
AUTHOR INDEX	92
REVIEWS	95
NEWS OF BIOLOGY IN THE SOUTHEAST	102
ABSTRACTS	104

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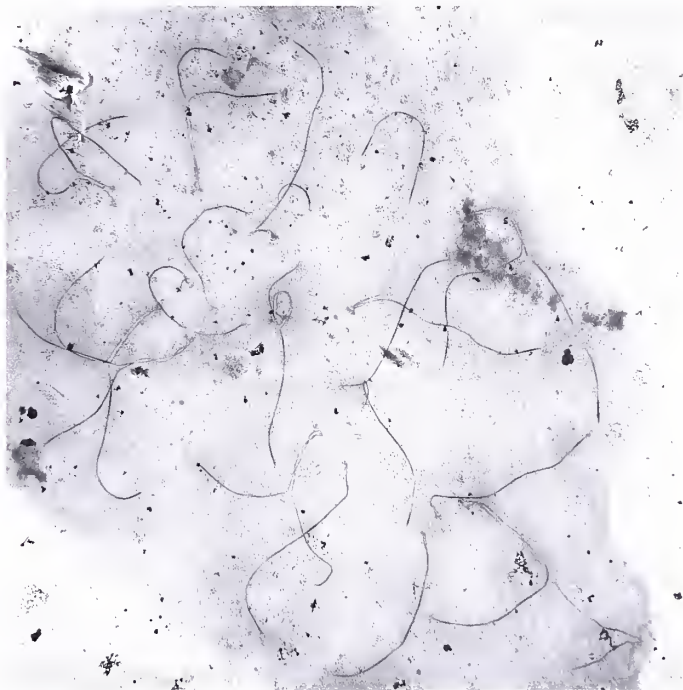
Volume 46, Number 3

September, 1999

***ONLY CALL FOR PAPERS FOR THE 61ST
MEETING***

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**NEW METHOD OF SUBMITTING
ABSTRACTS — SEE PAGE 206**



Synaptonemal Complex spread of Spider Meiosis

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PURPOSE

The purpose of this association shall be to promote the advancement of biology as a science by encouraging research the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. Members receive the *ASB Bulletin*.

TIME AND PLACE OF FUTURE MEETINGS

1999	April 14-17	University of North Carolina at Wilmington, Wilmington, NC
2000	April 5-8	University of Tennessee at Chattanooga, Chattanooga, TN
2001		Tulane University, New Orleans, LA

ASB PROUD

A message from the President



The Association of Southeastern Biologists is the oldest, largest, and most influential scientific organization of biologists in the Southeast. This is what our past President and recent Chair of the Resolutions Committee, Whit Gibbons, wrote in the cover letter attached to the ASB Resolutions that were mailed out to specific political leaders after the April 1999 Annual Meeting.

ASB is its members. Anyone who has attended one of our annual meetings knows this is a special group. You can feel the energy, enthusiasm, and dedication of the students, academic members, and non-academic professionals who participate.

One of my goals as President this year is to expand the membership base of ASB. A small group of ASB past Presidents (Eloise Carter, John Herr, Whit Gibbons, and Bill Martin) and I met at the April meeting and identified some key areas in which we felt we could make a difference. These areas include (1) colleges and universities in the proximity of the annual meetings, (2) larger colleges and universities in the Southeast, and (3) non-academic professionals from government and non-government agencies. Each of us has committed to following up with contacts in these specific areas.

Patron Members are crucial as supporters of ASB, as are our exhibitors at the annual meetings. The Patron Member and Exhibitor Committee, chaired by Robert Haynes, will be working on increasing their participation.

As members, we all can contribute to ASB membership in any of several ways: by reminding our friends and colleagues to join and attend the annual meetings, by suggesting an ASB symposium or workshop, by providing an article or photo cover for the *ASB Bulletin*, or by presenting a paper or poster at the annual meetings. Your ideas and assistance in expanding and diversifying our membership base, including new Patron members and exhibitors, are welcome. Just contact me or another officer (our addresses and phone numbers are on the inside cover).

ASB is its members, and we have the right to be proud. After all, we are the oldest, largest, and most influential scientific organization of biologists in the Southeast--and growing.

Pat Parr, ASB President

**EVENTS OF THE 1999 ANNUAL MEETING
AT THE UNIVERSITY OF NORTH CAROLINA AT WILMINGTON**

1999 Meritorious Teaching Award Presented to Ken Marion



The 1999 Meritorious Teaching Award went to Dr. Ken Marion of The University of Alabama at Birmingham. The award was presented at the ASB banquet in Wilmington, NC on April 16, 1999. Carolina Biological Supply Company sponsors the award, which consists of a plaque, a check for \$1,000 and includes the letters of support of Dr. Marion's nomination.

Dr. Marion, who was born in Sanford, Florida, has been teaching at the University of Alabama at Birmingham since 1971 and has held the rank of full professor since 1987. He received his A.B. (1966) and Ph.D. (1970) from Washington University in St. Louis, MO.

Ken has been a very active member of the Association of Southeastern Biologists, having served on many committees and been a member of the Executive Committee and served as President of the association in 1993-94. He has served as member of the board of Trustees of the Alabama Academy of Science, President of the Alabama Fisheries Association, President of the Southeastern Division of the American Society of Ichthyologists and Herpetologists, President of the Birmingham Herpetological Society, as well as being an active member of the Audubon Society and a number of other professional and civic organizations.

Dr. Marion has been described as an ecologist, a zoologist, a naturalist, a superior researcher, and a dynamic teacher. He has taught ecology, natural history of vertebrates, tropical ecology in the Bahamas, rainforest ecology in Costa Rica, reproductive physiology, and introductory biology. From the University of Alabama at Birmingham he has received the "Most Distinguished Professor Award" (1980)

and the "Most Outstanding Faculty Award" (1985-86). Both his students and colleagues have given him outstanding praise and high recommendations for his teaching, as the following quotes will verify:

"As a graduate student, I appreciated his relaxed and informal lecture style, which encouraged his students to ask questions and offer potential solutions to problems he posed to us. I have always felt that he contributed significantly to my own teaching."

"He taught me to make observations, design inquiries to explore those observations, and to question why. It was his attitude toward learning that convinced me that I should seek my graduate degree at UAB with Dr. Marion as my advisor."

Ken has always demonstrated a remarkable skill in making potentially complex subjects comprehensible to a wide range of students, ranging from children to senior adults."

"As a teacher, he enjoys the unusual distinction of being universally liked by his students and respected by his peers."

"In the classroom, he is a model of teaching excellence, sharing both expertise and enthusiasm. In the field, he demonstrates both scientific rigor and genuine concern for the subject organisms and their environment."

". . . he does a super job of instilling confidence, offering intellectual challenges, and providing motivation for the student he interacts with."

"I remember Ken as being there always for me, easy to talk to, and always with good guidance and suggestions. I have carried many of Ken's teachings forward to my younger high school students . . ."

"His legacy as a naturalist and a gifted teacher is well known throughout the state of Alabama and the Southeast. His exceptional teaching and communication skills are reflected in his numerous invited speaking engagements in K-12, colleges and universities, civic clubs, nature conservancies, and local government organizations."

The Association of Southeastern Biologists honors itself by the presentation of this most prestigious teaching award to Dr. Ken R. Marion of the University of Alabama at Birmingham.

CALL FOR NOMINATIONS FOR EDITOR OF THE *ASB Bulletin*

The Executive Committee of the Association of Southeastern Biologists would like to receive applications and/or nominations for editor of the *ASB Bulletin*. The successful candidate will assume editorial duties beginning with Issue 3 of Volume 47 (September, 2000). If you have any publication experience or interest, or if you know someone in ASB who does and who you think would be a good candidate, please send the information by 1 October to

Dr. Patricia Cox, Division of Biology
301 Hesler Hall, University of Tennessee
Knoxville, TN 37996

1999 Research Award Recipients

At the 1999 meeting of the Association, Mr. Travis J. Ryan won four research awards at the 1999 Annual Meeting of the Association of Southeastern Biologists for his paper "The ecology of life cycle evolution: "Growth metamorphosis, and maturation in *Ambystoma talpoideum*" *ASB Bull. Abstr.* 146 46(2), 1999 co-authored with Raymond D. Semlitsch. Mr. Ryan is a graduate student at the University of Missouri, Columbia and a Graduate Research Fellow at the Savannah River Ecology Laboratory.

His awards were:

- **ASB STUDENT RESEARCH AWARD:** sponsored by the Martin Microscope Co. of Easley, SC, and presented by Paul Schmalzer;
- **ASB STUDENT RESEARCH AWARD IN AQUATIC BIOLOGY:** sponsored by the Wildlife Co. (Wildco), and presented by Paul Schmalzer;
- **SE DIVISION, AMERICAN SOCIETY ICHTHYOLOGISTS AND HERPETOLOGISTS AWARD IN HERPETOLOGY.** The award was presented by George Cline;
- **EUGENE P. ODUM AWARD:** The award was presented by Cliff Hupp.

Winning four such awards is most unusual. The Association of Southeastern Biologists offers it sincere congratulations!

ASB FACULTY RESEARCH AWARD

was presented by Robert Haynes to Dr. Mark W. Hester of the Department of Biological Sciences, Southeastern Louisiana University and Dr. Irving A. Mendelssohn of Center for Coastal, Energy and Environmental Resources, LSU for their paper "Long-term Recovery of a Louisiana Brackish Marsh Plant Community from Oil-spill Impact: Vegetation Response and Mitigating Effects of Marsh Surface Elevation" *ASB Bull. Abstr.* 234, 46(2), 1999.

ASB POSTER AWARD

The ASB Poster Award was presented by Michael Held to Walter J. Diehl of Mississippi State University for his poster: "Natural selection in the entire primate lentiviral genome". *ASB Bull. Abstr.* 25, 46(2), 1999. Dr. Diehl's co-authors were C.R. Cooper of the University of Michigan and K. St. Cyr-Coats of Mississippi State University.

ELIZABETH ANN BARTHOLOMEW SERVICE AWARD

The Elizabeth Ann Bartholomew Award is presented to individuals who have distinguished themselves in professional and public service that advances our knowledge and appreciation of the world of plants and their scientific, cultural and aesthetic values. The 1998 award was presented by Ruth Douglas to Dr. Dan Evans, Professor of Biological Sciences and Curator of the Herbarium of Marshall University.

NORTH CAROLINA BOTANICAL GARDEN AWARD

The North Carolina Botanical Garden Award was presented by Dan Pittilo to Eric Menges for his paper "Comparative genetics of seven plants endemic to Florida's Lake Wales Ridge. Co-authors were Rebecca Dolan (Department of Biological Sciences, Butler University), Rebecca Yahr (Department of Botany, Duke University), and Doria Gordon (The Nature Conservancy and The University of Florida).

**THE ASSOCIATION OF SOUTHEASTERN BIOLOGISTS
TREASURER'S REPORT
1 JANUARY - 31 DECEMBER 1998**

I. BEGINNING BALANCE			\$54,124
II. RECEIPTS			
Regular Dues		\$17,445	
Patron Dues		2,000	
Meeting Revenue		19,465	
Enrichment		1,620	
Sales		34	
Interest		3,267	
Royalties		34	
Society of Wetlands Scientists, South Atlantic Chapter		500	
Carolina Biological Supply Co., Teaching Award		1,000	
TOTAL RECEIPTS			\$45,365
III. TOTAL RECEIPTS AND BEGINNING BALANCE			\$99,489
IV. DISBURSEMENTS			
1. Publication			
ASB Bulletin 45(1)	2,393		
ASB Bulletin 45(2)	6,555		
ASB Bulletin 45(3)	4,344		
ASB Bulletin 45(4)	2,121		
Miscellaneous	841		
Total Publication		16,254	
2. Office Expenses			
Web Page Development		650	
3. Official Travel		260	
4. Awards and Honoraria			
Graduate Student Support Grants	2,948		
Speaker Honorarium	1,000		
Speaker Travel	527		
Aquatic Biology Award	200		
ASB Research Awards	600		
Certificates/Plaques	162		
ASB Poster Award	300		
Teaching Award	1,000		
Total Awards		6,997	
5. Miscellaneous			
AIBS Affiliation	100		
Local Committee	1,100		
Symposia			
Education	500		
Women, Minorities, & Disabled	376		
Southeastern Society of Parasitologists	300		
Bank Charges	292		
Total Miscellaneous		2,668	
TOTAL DISBURSEMENTS			\$26,829
V. BALANCE			\$72,660
VI. NET CHANGE FOR 1998			\$18,536

1999 PROPOSED BUDGET

I.	BEGINNING BALANCE		\$72,660
II.	RECEIPTS		
	Regular Dues	\$17,050	
	Patron Memberships	2,000	
	Interest	1,500	
	Meeting Revenue: Exhibition	3,000	
	Sales	250	
	Registration	7,400	
	Carolina Biological Supply — Teaching Award	1,000	
	Society of Wetland Scientists, South Atlantic Chapter	500	
	TOTAL RECEIPTS		\$32,700
III.	TOTAL RECEIPTS AND BEGINNING BALANCE		\$105,360
IV.	DISBURSEMENTS		
1.	Dues Notice	500	500
2.	Publication		
	ASB Bulletin 45(1)	3,000	
	ASB Bulletin 45(2)	8,000	
	ASB Bulletin 45(3)	3,500	
	ASB Bulletin 45(4)	3,000	
	Misc. Publications	500	
	Total Publication		18,000
3.	Office Expenses		
	Web Page Development	500	500
4.	Official Travel	1,500	1,500
5.	Awards and Honoraria		
	Graduate Student Support Grants	4,100	
	Aquatic Biology Award	200	
	Speaker Honorarium	1,000	
	Speaker Travel	1,000	
	Research Awards	1,200	
	Certificates/Plaques	300	
	Poster Award	300	
	Teaching Award	1,000	
	Total Awards		9,100
6.	Miscellaneous		
	Affiliations	400	
	Local Committee	500	
	Symposia, Workshops	1,900	
	Bank Charges	200	
	Web Site	100	
	Total Miscellaneous		3,100
	TOTAL DISBURSEMENTS		\$32,700
V.	NET BALANCE FOR YEAR		0.00
VI.	BALANCE FORWARDED		\$72,600

ENRICHMENT FUND
I JANUARY - 31 DECEMBER 1998

I. Beginning Balance		\$26,590
II. Receipts		
1. Gifts	1,620	
2. Interest	1,244	
Total		2,864
III. Total Receipts and Beginning Balance		29,454
IV. Total Disbursements		0
V. Ending Balance		29,454
VI. Net Change for 1997		2,864

CASH ON HAND
31 DECEMBER 1998

I. Merrill Lynch	\$11,714
II. Wachovia	
1. Enrichment	29,454
2. Money Market	60,189
TOTAL	\$101,357



Robert Haynes presents the Faculty Research Award to Dr. Mark W. Hester

**ASB OFFICERS, COMMITTEES AND REPRESENTATIVES AND
ASB BULLETIN STAFF, 1999 - 2000**

Telephone numbers, FAX numbers and E-mail addresses
can be found on the inside front cover of each issue of the *ASB Bulletin*.

ASB Bulletin Staff

Editor	J. Kenneth Shull, Jr., Department of Biology, Appalachian State University, Boone, NC
Associate Editor	Andrew Ash, Department of Biology, Pembroke State University, Pembroke, NC
Business Manager	Tim Atkinson, Carolina Biological Supply Co., Burlington, NC
News Editor	Jon Fortman, Division of Science and Mathematics, Mississippi University for Women, Columbus, MS
Book Review Editor	Frank Schwartz, Institute of Marine Sciences, University of North Carolina, Morehead City, NC

ASB Officers

President	Pat Parr, P. O. Box 2008, Oak Ridge National Laboratory, Oak Ridge, TN
President-elect	Howard Neufeld, Department of Biology, Appalachian State University, Boone, NC
Vice-President	Dwayne Wise, Department of Biology, Mississippi State University, Starkeville, MS
Past President	Eloise Carter, Department of Biology, Oxford College of Emory University, Oxford, GA
Secretary	Andrew Ash, Department of Biology, Pembroke State University, Pembroke, NC
Treasurer	Tim Atkinson, Carolina Biological Supply Co., Burlington, NC
Archivist	Sandra Bowden, Department of Biology, Agnes Scott College, Decatur, GA

Executive Committee Members-at-Large

2000:	Patricia Cox, Division of Biology, University of Tennessee, Knoxville, TN
	Terry Richardson, Department of Biology, University of North Alabama, Florence, AL
2001	George Cline, Department of Biology, Jacksonville State University, Jacksonville, AL
	Joe Pollard, Department of Biology, Furman University, Greenville, SC
2002	Gerhard Kalmus, Department of Biology, East Carolina University, Greenville, NC
	Bonnie Kelley, Dept. of Biology, University of North Carolina at Pembroke, Pembroke, NC

ASB Committees 1999-2000**AAAS Representative (Section G)**

James W. Ross, Biology Department, Cumberland College, 7196 College Station Drive, Williamsburg, KY 40769-1382, (606) 539-4380

AIBS Representative

Geraldine Twitty, Biology Department, Howard University, Washington, DC 20059, (202)806-6946

Auditing Committee

Chair: to be determined

Committee on Women, Minorities and the Disabled

Chair 1999: Lonnette Edwards, U.S. Forest Service, Department of Plant and Soil Science, PO Box 1387, Alabama A & M University, Normal, AL 35762, (256) 858-4233, fax (256) 858-8275; 2000: Sue Carstensen, Biology Department, Columbia College, Columbia, SC 29203 (803)786-3012, scarstensen@colacoll.edu; 2001: Irene Kokkala, North Georgia College and State University, Department of Biology, Dahlonega, GA 30597, (706) 864-1368, ikokkala@ngcsu.edu.

Conservation Committee

Chair 1999: Doug Rayner, Department of Biology, Wofford College, Spartanburg, SC, (864)597-4624, raynerda@wofford.edu; 2000: Nancy Coile, FDACS - Division of Plant Industry, PO Box 147100, Gainesville, FL 32614-7100, coilen@doacs.state.fl.us; 2001: Virginia Tolbert, Oak Ridge National Laboratory, PO Box 2008, Oak Ridge, TN 37831-1059, (423) 574-7288, vrt@ornl.gov

Education Committee

Co-Chair 1999: John Aliff, DeKalb College, Decatur, GA 30243, (770) 339-2328; Co-Chair 1999: Herbert House, Department of Biology, Elon College, Elon College, NC 27244, (336) 584-2294; 2000: Larry Wilson, Fernbank Science Center, 156 Heaton Park Drive, Atlanta, GA 30307, (404)378-4314 ext. 331, larrywilson@fernbank.edu; 2000: William Dobson, Biology Department, Appalachian State, Boone, NC 28608, (828)262-6910, dobsonwe@appstate.edu; 2001: Barbara Rfaill, Georgetown College, 400 E. College St, Biology Department, Georgetown, KY 40324, (502) 863-8085, brafaill@georgetowncollege.edu; 2001: Don Hauber, Department of Biological Sciences, Loyola University, New Orleans, LA 70118, (504) 865-2769, hauber@loyno.edu

Finance Committee

Chair: Tim Adkinson, Carolina Biological Supply Company, (336) 538-6224; J. Whitfield Gibbons, Savannah River Ecology Laboratory, Drawer E, Aiken, SC 29802, (803)725-3533, gibbons@srel.edu; Joe Pollard, Biology Department, Furman University, Greenville, SC 29613, (864) 294-3244, joe.joe.pollard@furman.edu; Gerhard Kalmus, Department of Biology, East Carolina University, Greenville, NC 28785, (919) 328-6306, kalmusg@mail.ecu.edu.

Graduate Student Support Award Committee

Chair 1999: Mike Dorcas, Department of Biology, PO Box 1719, Davidson College, Davidson, NC 28036, (704) 892-2672, fax (704) 892-2512, midorcas@davidson.edu; 2000: Dean Cocking, Department of Biology, James Madison University, Harrisonburg, VA 22807, (540)568-6566, cockinwd@jmu.edu; 2001: Isaure de Buron, Converse College, 580 E. Main Street, Spartanburg, SC 29302-0006, (864) 596-9210, isaure.deburon@converse.edu

Local Arrangements and Program Committee for 2000 Annual Meeting

Chair: Mark Schorr, Department of Biological and Environmental Sciences, UTC, 615 McCallie Ave., Chattanooga, TN 37403-2598, (423) 755-4149, Mark-Schorr@utc.edu; Program Chair: Tim Gaudin, Department of Biological and Environmental Sciences, UTC,

615 McCallie Ave., Chattanooga, TN 37403-2598, (423) 755-4163, Timothy-Gaudin@utc.edu

Meritorious Teaching Award Committee

Chair 1999: Ron Dimock, Wake Forest University, Winston-Salem, NC 27106-5848; 2000: Stewart Ware, Department of Biology, College of William & Mary, PO Box 8795, Williamsburg, VA 23187, (757) 221-2233, fax (757) 221-6483, saware@facstaff.wm.edu; 2001: Rebecca Cook, Biology Department, Lambuth College, Lambuth Blvd., Jackson, TN 38301, (901) 425-3278, cook-reb@lambuth.edu

Nominating Committee for 2000

Chair: J. Whitfield Gibbons, Savannah River Ecology Laboratory, Drawer E, Aiken, SC 29802, (803) 725-3533, gibbons@srel.edu; Mike Baranski, Department of Biology, Catawba College, Salisbury, NC 28144, (704) 637-4442, mbaransk@catawba.edu; Don Shure, Department of Biology, Emory University, Atlanta, GA 30322, (404) 727-4209, dshure@biology.emory.edu

Past President's Council

Chair: Eloise Carter, Oxford College of Emory University, PO Box 1328, Oxford, GA 30054, (770) 784-8343, ecarter@emory.edu;

Place of Meeting Committee

Chair 1999: Joe Pollard, Department of Biology, Furman University, Greenville, SC 29613, (864) 294-3244, joe.pollard@furman.edu; 2000: Kim Tolson, Biology Department, North East Louisiana University, Monroe, LA, 71209, bitolson@alpha.nlu.edu; 2001: Robert George, Biological Sciences, Wilmington, NC 28403-3297, (910) 962-3487, georger@uncwil.edu

Poster Awards Committee

Chair 1999: John Aho, Department of Biology, Auburn University of Montgomery, Montgomery, AL (334) 244-3787, dartmoor@sciences.aum.edu; 2000: George Cline, Department of Biology, Jacksonville State University, Jacksonville, AL 36265, (205) 782-5798, gcline@jsucc.jsu.edu; 2001: Steve Baker, Department of Biology, Oxford College of Emory University, Oxford, GA 30054, (770) 784-8446, fax (770) 784-8423, sbaker@emory.edu

Publications Committee

Chair 1999: Patricia Cox, Division of Biology, University of Tennessee, 301 Hester Hall, Knoxville, TN 37996, (423)974-6225, pbcox@utkux.utccc.utk.edu; 2000: George Cline, Department of Biology, Jacksonville State University, Jacksonville, AL 36265, (205)782-5798; 2001: Bonnie Kelly, UNC at Pembroke, Biology Department, Pembroke, NC 28372, (910) 521-6419, kelley@nat.uncp.edu

Research Awards Committee - Faculty

Chair 1999: Walter Diehl, Mississippi State University, Drawer G4, Mississippi State, MS 39762-5759 (601) 325-7576, wjdiehl@ra.msstate.edu; 2000: Tom Wentworth, Department of Biology, North Carolina State, Box 7612, Raleigh, NC 27695-7612, (919)515-2168, Tom_wentworth@ncsu.edu; 2001: John Herr, University of South Carolina, Department of Biological Studies, Columbia, SC 29208, (803) 777-8110, herr@biol.sc.edu.

Research Awards Committee - Student

Chair 1999: Lew Stratton, Furman University, Greenville, SC 29613; 2000: Scott Franklin, Department of Biology, University of Memphis, Memphis, TN 38152-6081, (901)678-5539, sfrankli@memphis.edu; 2001: Richard Henson, Dept. of Biol. Appalachian State University, Boone, NC 28608; (828)262-2677; hensonrn@appstate.edu.

Resolutions Committee (1 year appointments)

Chair: Eloise Carter, Oxford College of Emory University, PO Box 1328, Oxford, GA 30054, (770) 784-8343, ecarter@emory.edu ; Mark Schorr, Department of Biological and Environmental Sciences, UTC, 615 McCallie Ave., Chattanooga, TN 37403-2598, (423) 755-4149, Mark-Schorr@utc.edu ; Paul Davison, Department of Biology, University of

North Alabama, Florence, AL 35632, (256) 765-4434, pdavison@unanov.una.edu

Patron Member and Exhibitor Committee

Chair 1998-2000: Robert Haynes, Department of Biology, University of Alabama, Tuscaloosa, AL 35487, (205) 348-1826, rhaynes@biology.as.ua.edu; Vice-Chair 1999-2001: Terry Richardson, University of North Alabama, PO Box 5212, Biology Department, Florence, AL 35632, (256) 765-4429, trichard@unanov.una.edu; ASB V-P 1999-2000: Dwayne Wise, Mississippi State University, PO Drawer GY, Mississippi State, MS 39762, (601) 325-7579, daw1@ra.msstate.edu; Past-Chair Local Arrangements: Robert George, University of NC at Wilmington, Department of Biological Sciences, 601 South College Road, Wilmington, NC 28403-3297, (910) 962-3611, georger@uncwil.edu

Enrichment Fund Board

Chair 1998-2001: Dwayne Wise, Mississippi State University, PO Drawer GY, Mississippi State, MS 39762, (601) 325-7579, daw1@ra.msstate.edu; Members of the Executive Committee and Finance Committee comprise the Enrichment Fund Board.



Walter Diehl receives the ASB Poster Award from Michael Held



Pat Parr receives the gavel from Eloise Carter

2000 MEETING OF THE ASSOCIATION

CALL FOR PAPERS
THE 61ST ANNUAL MEETING
HOST: UNIVERSITY OF TENNESSEE
AT CHATTANOOGA
MEETING SITE: CHATTANOOGA, TN
DATE: 5-8 APRIL 2000

NOTE WELL!

This will be the only call for papers.

Please note the following deadlines which are to be met before our 61st Annual Meeting hosted by the University of Tennessee at Chattanooga.

- 19 November** Titles and abstracts of papers and posters (use electronic submission format described below). They must reach the program chairman by this date.
- 15 October** Nominations for ASB officers and executive committee.
- 15 November -
2 February** Submissions for research awards.
- 2 February** Application for student travel awards.

NOTICE

ASB and the Local Committee wish to encourage greater use of posters as an effective means of presentation. All posters will automatically be entered in a judging for a \$300 prize. Please consider whether your presentation could be given in the form of a poster. All posters will be eight feet wide and four feet high. You must provide pins for mounting posters.

PAPER & POSTER SUBMISSION FORMS FOR 2000 MEETING
DEADLINE: 19 November 1999

Individuals presenting papers or posters are expected to be members of ASB!

NOTE! SEE NEW INSTRUCTIONS ON SUBMITTING ABSTRACTS!

This form and the abstract in an attachment file or on a 3 ½ inch diskette sent to the Program Chairman, Dr. Timothy J. Gaudin, Department of Biological and Environmental Sciences, Dept. 2653 615 McCallie Ave., Chattanooga, TN 37403-2598, Forms must be received no later than **19 November 1999** for the title to appear on the program and the abstract to be published in the April 2000 ASB Bulletin. In the event of a last-minute absence, notify Dr. Gaudin at the above address or by phone, (423)755-4163 fax (423)785-2285, e-mail Timothy-Gaudin@utc.edu.

Please type or print carefully. Provide the phone/fax numbers and e-mail address for the primary author only.

1.	Author(s):	
2.	Institution(s):	
3.	Phone: ()	Fax: ()
4.	Title (omit higher taxa--see No. 8 below):	

5. **Check:** ☐ Paper or ☐ Poster See notice on previous page. Further instructions will appear in the January *ASB Bulletin*.

6. **PROJECTION EQUIPMENT:** ☐ 35 mm slides, ☐ Overhead
 ☐ Other (specify): _____

Time limit for presentations and questions is 15 minutes. Plan on speaking for 10-12 minutes to leave time for questions.

7. **Recommended Section:** Check appropriate section(s) to which your paper/poster should be assigned. If you check more than one, rank sections as to your preference (with "1" being first preferred). Indicate **Higher Taxon** to help program committee in arranging papers (omit these from the title unless necessary). Paper sections will be established based on needs. Posters will be grouped by subject area.

☐ Animal physiology	☐ Herpetology	☐ Parasitology
☐ Aquatic, wetland & marine ecology	☐ Ichthyology	☐ Plant ecology
☐ Developmental biology	☐ Invertebrate zoology & entomology	☐ Plant physiology
☐ Genetics, cell & molecular biology	☐ Mammalogy	☐ Plant systematics
	☐ Microbiology	☐ Teaching biology
	☐ Ornithology	
Other:		

NOTE WELL!

8. **Abstract:** This year all abstracts should be submitted electronically. It is preferable to send the abstract as an **attached file** to an electronic mail directed to the following address: Timothy-Gaudin@utc.edu (note the capitalization and hyphen). Please **do not** paste the abstract into the body of an e-mail message. If you do not have software capable of sending files as attachments, then send it as a **file on a 3.5" diskette**. In either case, it is preferred that the file be in a **Microsoft Word (either Mac, Windows or DOS is acceptable)**. If you do not have access to Microsoft Word, **WordPerfect** is acceptable. The file must be in **12 point Times New Roman, C G Times or Arial with margins of 1 inch right and 2 ½ inches left. NOTE! INDENT THE TITLE AND AUTHOR(S) FIVE SPACES! The abstract must not exceed 200 words.** Directions for completing the abstract are provided below and at the following web site: <http://www.utc.edu/~guthrie/ASB/>. If you have any additional questions, you may contact the Program Chair, Dr. Tim Gaudin, e-mail: Timothy-Gaudin@utc.edu; phone (423)755-4163; fax: (423)785-2285. **Please read all the instructions before typing your abstract. Abstracts that do not conform to the requested format will be returned to you for revision. If the revised abstract is not received before the abstract deadline it will not appear in the ASB Bulletin.** If you do not have computer capability, the "blue forms" that have been used in the past can be submitted and can be obtained from the editor: Dr. J. Kenneth Shull, Jr. at the address listed in the inside front cover of this issue of the *ASB Bulletin*.

ABSOLUTE REQUIREMENTS

IF THE FIRST EIGHT INSTRUCTIONS ARE NOT FOLLOWED EXACTLY, YOUR ABSTRACT WILL BE RETURNED TO YOU FOR REVISION. IF IT IS PAST THE DEADLINE THE ABSTRACT WILL NOT APPEAR IN THE *ASB BULLETIN*!

1. Type in the following order: AUTHOR'S NAME(S) (all capitalized; last name first for first author, other authors"(if any) names, first names first. If more than one author, separate names with "AND,". In the case of more than two authors, separate all but last name with a comma, separate the last two with ", AND"; end with a period. Institution(s) (follow name directly; maintain same indentation as name; end with a dash(-). Title (start after the dash without a space; capitalize first letter of first word then only proper and scientific names as customary; underline all of title; maintain same indentation as name and institution; end with a period.) Leave 1/4 inch (two full spaces) between title and text.
2. In case of two or more authors with different institutions, place all author names together first, followed by all institutions in the same order; if necessary, key author to institution by a superscript number. See example below or on the website.
3. Start text on a new line. Do not indent first line. Use one paragraph for entire text. Do not put any reference citations in the abstract. Justify both left and right margins for best appearance.
4. Single space all typing. Put all taxonomic names in *italics*.
5. If a grant source *must* be acknowledged, place at end of text without a new paragraph.

EXAMPLES

RADENBAUGH, TODD A. United States Peace Corps,
Jamaica - Major plant community types of Duncan Bay,
Jamaica, West Indies.

There is an urgent need to record and describe the coastal ecosystems on the North coast of Jamaica before they are severely altered by human influences. A

DAVIS, JENNIFER AND DWAYNE WISE. Shorter College and Mississippi State University - Causes and consequences of elevated levels of meiotic abnormalities in laboratory colonies of the crane fly *Nephrotoma suturalis*.

Progeny of five wild-caught crane flies were compared to a laboratory colony of *Nephrotoma suturalis* for mean % chromosomal

JOPLIN, KARL H.¹, RONALD D. FLANNAGAN², AND DAVID DENLINGER². ¹Dept. Biological Sciences, East Tennessee State University, Johnson City, TN 37614 and ²Dept. Entomology, Ohio State University, Columbus, OH 43210 - Cloning of diapause specific genes of the flesh fly, *Sarcophaga crassipalpis*.

Insects in temperate climates use diapause as an overwintering strategy. This developmental state is signalled by environmental cues,

9. **NOTE:** If you wish to be notified of the day and time of your presentation, please include a self-addressed, stamped post card with this Title Sheet. Indicate title, your name, and leave a blank for day and time.
10. **Awards:** If you intend to submit an abstract and manuscript, please select from the following categories (see this *ASB Bulletin* for instructions; some require a manuscript. All posters will automatically be considered for the Poster Award (\$300.)
 - ☐ ASB Student Research Award (\$600) ☐ ASB Faculty Research Award (\$600)
 - ☐ Odum Award (\$250) ☐ Aquatic Biology Student Award (\$100)
 - ☐ NC Botanical Garden Award (\$100) ☐ SEASIH Ichthyology Award (\$100)
 - ☐ SEASIH Herpetology Award (\$100)
11. **Reprints** of abstracts are not available. You may duplicate the printed abstracts from the *ASB Bulletin*.
12. **Important:** In case of error in your name or title when printed or questions about your presentation, please notify the Program Chair, Dr. Tim Gaudin, as soon as possible – not the moderator of your paper session.

GUIDELINES FOR POSTER SESSION AND ASB POSTER AWARD (\$300)

Poster sessions have been incorporated as a regular means of scientific presentation at the annual ASB meetings. This type of presentation provides a more informal environment that encourages a direct interchange of ideas and discussion between presenter and audience. In order to stimulate greater use of posters as an effective means of presenting research results, ASB awards a \$300 cash prize to the best poster presentation. All posters will automatically be entered in a judging for the Poster Award. Adherence to the following guidelines will help ensure the effectiveness of the poster presentation and consideration for the award.

- (a) Posters must fit in an area 8 feet wide and 4 feet high. Presenters must provide their own pins to attach posters to poster boards.
- (b) Posters must be displayed from 10:00 a.m. Thursday through 5:00 p.m. Friday. Authors will be required to be present at specified times during the annual meeting.
- (c) Posters should be carefully planned to maximize clarity and simplicity in conveying information.
- (d) Poster should have a heading including a title, author, and author's institution(s). This heading should be placed at the top in letters no less than 3 cm high.
- (e) The body of the poster, including text, figure legends and table captions, should be in type no smaller than 18 pt. (3-4 mm) and *must* be legible from a distance of about 1-2 meters.
- (f) The body should be self-explanatory and should include figures, tables, graphs, maps, or photographs displayed in a well organized, coherent, and easy-to-follow sequence from top to bottom. Each illustration should contain a caption. *Do not over crowd the display.*
- (g) A limited degree of text may be included, but care should be taken not to overwhelm the audience.
- (h) A large, abbreviated version of the abstract should be presented at the top of the poster, but below the heading. A clear listing of specific conclusions should appear at the bottom or end of the presentation.
- (i) In addition to adherence to the above listed guidelines, poster presentations will also be judged using the following specific criteria:
 - (i) overall aesthetics and attractiveness of presentation.
 - (ii) ease of reading from a distance (1-2 meters).
 - (iii) clear and concise organization.
 - (iv) clearly stated hypothesis.
 - (v) soundness of methods for testing hypothesis.
 - (vi) how well conclusions are supported by results

Further inquiries may be directed to the chair of the ASB Poster Award Committee: Dr. John Aho, Department of Biology, Auburn University of Montgomery, Montgomery, AL (334) 244-3787, dartmoor@sciences.aum.edu

**NOMINATION FOR ASB OFFICERS AND EXECUTIVE
COMMITTEE POSITIONS**

DEADLINE: 15 OCTOBER 1999

To members of the Nominating Committee: I wish to suggest that you consider the following ASB member(s) in selecting nominees for officers and executive committee positions. (Please include the institutional address of each nominee.)

PRESIDENT-ELECT

VICE-PRESIDENT

SECRETARY

EXECUTIVE COMMITTEE
(two will be elected for three-year terms.)

MAIL To: Dr. Whit Gibbons, Savannah River Ecology Laboratory
Aiken, SC 29802

(803) 725-5852 gibbons@srel.edu

NAME & ADDRESS OF NOMINATOR

**"TRAVEL" SUPPORT AWARDS FOR GRADUATE
STUDENT MEMBERS OF ASB**

DEADLINE: 2 FEBRUARY 2000

Limited funds are available to partially defray the expenses of graduate students attending the Annual Meeting. The awards are for lodging and meals only. Departments are urged to provide transportation for their graduate students. *Recipients must be members of ASB.* The guidelines for application are as follows:

- (a) *The recipient is a current member of ASB.*
- (b) The recipient must be presenting a paper or poster at the Annual Meeting and must include a copy of the abstract of the paper or poster to be presented.
- (c) The recipient must be currently enrolled as a graduate student in the department where he/she conducted this research.
- (d) Give a conservative, itemized estimate of meeting expenses including transportation. Student travel awards are granted on a competitive basis. Applicants must document expected expenses and list other sources of financial support for this meeting, including institutional aid, shared lodging and shared transportation.
- (e) In a paragraph, give a brief history of your education to date; indicate how many years you have been in graduate school and the expected date of completion of work for the degree, your major field of study and research, publications including those in press and in preparation, degree sought, name of major professor and any other pertinent details.
- (f) Give your source(s) of support while in graduate school; e.g. NSF, NIH, USDA, Teaching Asst., Research Asst., etc.
- (g) Include a letter of recommendation for an ASB support award from your faculty research advisor. This letter should comment on the work being presented and indicate the financial need of the student presenter. It should also indicate whether any departmental or other funding is available to the student.
- (h) Send application, with supporting letter, all in triplicate, to: Dr. Gary Walker, Department of Biology, Appalachian State University, Boone, NC 28608, (704)262-2672.
- (i) Applicants will be notified of the decision of the Committee as soon as is practical. Recipients of the award will receive their checks at the meeting.

HONOR THY TEACHER!

ASB MERITORIOUS TEACHING AWARD: DEADLINE FEBRUARY 1, 2000

Each year the ASB recognizes one of its members for especially meritorious teaching. Carolina Biological Supply Company, Burlington, NC, has generously sponsored this \$1000 award, which will be presented together with an appropriate citation at the Annual Banquet in Chattanooga in April, 2000.

Nominees must be members of ASB who are actively engaged in, or recently retired from, the teaching of biology in any southeastern college or university. Successful candidates typically have been teaching for at least 10 years, but there are no restrictions on size of the institution, presence of graduate program, etc. The Award simply is for highly effective teaching. There are many deserving members of ASB. However, they cannot nominate themselves, so former students or colleagues must take an active role in assembling the materials that the Committee then will evaluate.

Take the lead, pass the word – serve as the coordinator and nominate a deserving teacher! Solicit supporting letters from the nominee's present and former students. Contact his or her colleagues for additional endorsements. Be sure to include any form of recognition by the nominee's home institution of excellence in teaching, or special assignments or mentoring roles facilitating good teaching. Of special note would be the number and quality of students for whom the nominee provided primary inspiration to continue in biology, especially for students who subsequently earned advanced degrees. In short, document the educational impact this individual has made by virtue of his or her role as a biology professor.

Nominators should send a current *curriculum vitae* and all relevant documents, together with the Nomination Form for the Meritorious Teaching Award, to: Dr. Ron Dimock, Department of Biology, Wake Forest University, Winston-Salem, NC 27109. Submit all materials in triplicate by the Feb 1 due date. If you have any questions, please call me at 336-758-5567 or send email to: dimock@wfu.edu. Previously nominated candidates who did not receive the award may be re-nominated, with updated supporting materials. The Committee would welcome the task of deciding among several candidates.

Thanks for taking this initiative.

Ron Dimock, Chair
Meritorious Teaching Award Committee

NOMINATION -- ASB MERITORIOUS TEACHING AWARD, 2000

NAME:

ADDRESS:

TEACHING INTERESTS:

NOMINATOR NAME/ADDRESS:

Supporting documentation:	letter of nomination	
(enclosed, in triplicate __)	supporting letters	
curriculum vitae	additional information (list)	



Bob McGuire presents the Meritorious Teaching Award to Ken Marion

RESEARCH AWARDS

ASB STUDENT RESEARCH AWARD (\$600) AND ASB SENIOR RESEARCH AWARD (\$600)

Given for an especially meritorious manuscript presented orally by the author(s) at the Annual Meeting. In order to qualify for presenting the paper, the author(s) must submit an abstract by the November deadline. Papers submitted for the competition must be received in triplicate and in their entirety by the January deadline and must be journal-ready manuscripts worthy of publication. The student award is given to the senior author if she/he is a graduate or undergraduate student at the time of presentation. To qualify, author(s) must submit an abstract, title form, and application for the award by 22 November 1999, and four copies of the journal-ready manuscript with abstract, title form, and short biographical sketches of each author by 29 January 2000. Only ASB members are eligible. Judges will use a standard evaluation form that includes the following criteria: significance of ideas, soundness of hypotheses, originality (creativity), quality of methodology, validity of results, soundness of conclusions, clarity, completeness, organization, and contribution to the field. At the discretion of the Research Award Committees, the award may be withheld or it may be split in the case of a tie. Papers may be in press, but not published prior to the previous annual meeting.

Committee Chairs:

Faculty — Walter Diehl, Mississippi State University, Drawer G4, Mississippi State, MS 39762-5759; wjdiehl@ra.msstate.edu; (601) 325-7576.

Student — Lew Stratton, Furman University, Greenville, SC 29613; (864)294-3249. lew.stratton@furman.edu;

ASB STUDENT RESEARCH AWARD IN AQUATIC BIOLOGY (\$200)

Sponsored by Wildlife Supply Company (WILDCO), the purpose of the award is to encourage excellence in aquatic biology research by undergraduate and graduate students. Students who are members of ASB and whose work is sponsored by a professional biologist who is also an ASB member are eligible. The paper must be based on research designed and completed by the student and it must be presented orally by the student as senior author at the Annual Meeting. To be eligible, author(s) must submit an abstract, title form, and application for the award by 15 November 1999, four copies of the journal-ready manuscript with abstract, title form, and short biographical sketches of each author by 29 January 2000 and a letter from the sponsor affirming student status at the time the research was completed and sponsorship of the student to the chair of the Student Research Award Committee. Judges will use a standard evaluation form that includes the following criteria: significance of ideas, soundness of hypotheses, originality (creativity), quality of methodology, validity of results, soundness of conclusions,

clarity, completeness, organization, and contribution to the field. At the discretion of the Student Research Award Committee, the award may be withheld or it may be split in the case of a tie. It is intended that aquatic biology be broadly interpreted. For example, research projects on aquatic organisms, wetland biota, and water quality are all eligible. Committee Chair: Lew Stratton, Furman University, Greenville, SC 29613; lew.stratton@furman.edu; (864)294-3249.

EUGENE P. ODUM AWARD (\$500)

Given by the Southeastern Chapter of the Ecological Society of America for the best ecological paper presented by a student. Undergraduate and graduate students are eligible and the student must be the sole or senior author. The paper must deal with a clearly ecological topic and should be presented in any of the following sessions: Aquatic Ecology, Plant Ecology, or Animal Ecology. One copy of the title and abstract should be sent to the Program Chair by November 19, and a second copy to Dr. Ken Marion, Biology Department, University of Alabama at Birmingham, Birmingham, AL 35294; (205)934-3582; kmarion@uab.edu.

ASB STUDENT RESEARCH AWARD IN AQUATIC BIOLOGY (\$100)

Sponsored by WILDCO, the purpose of the award is to encourage excellence in research in aquatic biology by undergraduate and graduate students. Students who are members of ASB and whose research is sponsored by a faculty member or biology professional who is also an ASB member are eligible. The paper must be based on research designed and completed by the student and the paper must be presented orally by the student as senior author in a regular paper session at the Annual Meeting. The manuscript must conform to the style and general content of peer-reviewed journals in the area of aquatic biology. It is intended that aquatic biology be broadly interpreted; for example, the research could involve an entomological project or an aquatic insect.

All students entering a paper to be considered for the award should send an abstract to the program chair by 15 November 1999 and a manuscript, in triplicate, to Chair: Lew Stratton, Furman University, Greenville, SC 29613; (864)294-3249; lew.stratton@furman.edu.

THE NORTH CAROLINA BOTANICAL GARDEN AWARD (\$100)

Given by NCBG (through the Southeastern Section of the Botanical Society of America and the Southern Appalachian Botanical Society.) This is awarded for a paper presented at the annual ASB meetings that best advances our understanding of the biology and conservation of the southeastern plants and thus contributes to the mission of the North Carolina Botanical Garden. Of special interest to the Garden are the rare plant species of the Southeast: why they are rare; how they interact with plants, animals, and their environment; and what can be done to ensure their

survival. The paper may deal with a broad area including systematics, ecology and conservation. All individuals who are eligible to present at the ASB meetings are eligible for this award. They may be students, faculty or others.

Awards Committee Chair: Dr. Peter White, Department of Biology, CB3280, University of North Carolina, Chapel Hill, NC 27599.

**SOUTHEASTERN DIVISION OF THE
AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS
OUTSTANDING STUDENT PAPER AWARDS
ICHTHYOLOGY PAPER (\$100); HERPETOLOGY PAPER (\$100)**

These awards are given for the outstanding papers in the disciplines of ichthyology and herpetology presented by student members of the Southeastern Division of the American Society of Ichthyologists and Herpetologists (SEASIH.) Both undergraduate and graduate students are eligible, provided they are sole or senior author and the paper clearly deals with a topic concerning ichthyology or herpetology. To be considered submit title and abstract to the ASB Program Chair by 15 November 1999. A second copy should be sent by the same date to the SEASIH President: Dr. Floyd Scott, Department of Biology, Austin Peay State University, Clarksville, TN 37044. Winners will be announced at the ASB banquet.

NOTE: A limited number of "travel" grants (\$50 each) are available to selected student members of SEASIH who will be presenting papers or posters in ichthyology or herpetology at the annual ASB meeting. Students seeking travel awards should provide a brief justification for their request by 1 February 2000 to Dr. Floyd Scott at the address above.

The following abstract was omitted from the April issue of the *ASB Bulletin*:

Musselman, Lytton John¹, M. Fawaz Azmeh², and Majd Jamal². ¹Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529-0266 and ²Faculty of Agriculture, University of Damascus, P.O. Box 30821, Damascus, Syria. A unique *Isoetes* from Syria.

The only *Isoetes* in the Middle East is known from Jebel Arab (also known as Jebel Druze) in southern Syria. Jebel Druze is a series of ancient volcanoes reaching 1700 m and supporting a few distinctive wetlands. *Isoetes olympica* A. Braun has been noted at two sites on Jebel Arab as well as two locations in Turkey. A single collection from the early 1930's is the only herbarium material from Syria. In April 1998, a population was relocated on Jebel Arab. This is threatened with immediate destruction. Megaspores are distinctly tuberculate with a broad equatorial ridge that is also ornamented. Microspores are echinate and possess a distinct micro ornamentation consisting of long rod-like protrusions. Preliminary studies indicate that the spores of the Syria plant are similar to those from Turkey. Cultures of the plant are being used for cytological and molecular systematic studies to determine relationships among the few species found in the eastern Mediterranean region.

REVIEWS

Dr. Frank Schwartz, Review Editor
Institute of Marine Science, 3431 Arendell St.
University of North Carolina, Morehead City, NC 28557

Cunningham, William P. and Barbara Woodworth Saigo, 1999. **Environmental Science: A Global Concern**, 5th ed. WCB/McGraw-Hill, Boston, xxii + 650 pp., \$50 hardbound.

Here in North Carolina, the pollution of the Neuse River watershed is a complex environmental problem that has generated considerable political controversy in recent years. Nutrients from the central and eastern portions of the state have caused fish kills and eutrophication in the river and in coastal estuaries. They enter the river not only directly from municipal wastewater outfalls, but also indirectly from surface runoff and groundwater transport of residential and agricultural fertilizers, from atmospheric deposition of evaporated animal wastes in storage lagoons, and from other pathways. Local residents are affected by odors from the lagoons and fishermen are affected by the dinoflagellate *Pfiesteria* in the river. Overlaying these environmental issues are technical, economic, legal, and political issues associated with urban growth and large-scale hog farming. Legislators and regulators must understand all aspects of the problem if the solutions that they develop are to be protective of the environment, efficient, cost-effective, and equitable for all involved parties. Concerned citizens must also master this broad range of subject matter.

Environmental Science: A Global Concern provides much of the basic scientific information that is needed to understand the Neuse River problem. It is intended for use in a one- or two-semester course on environmental science, human ecology, or environmental studies at the college level. However, it is better suited for use in a survey course for non-majors than in a course for environmental science majors who need more detailed knowledge of the scientific, economic, and political disciplines that intersect with environmental science.

The first 24 chapters of the textbook address topics such as: scientific uncertainty, environmental and ecological principles, population dynamics, health effects, biological diversity, air and water pollution, energy resources, and urbanization. Each topic is presented relatively briefly and in nontechnical terms, but the basic principles and the major issues are addressed in reasonable detail for a survey course. Case studies and in-depth essays present real-life examples that illustrate the topics. "What can you do?" sidebars provide every-day examples of steps that one can take to protect the environment. Abundant figures and tables are clear and generally help in the comprehension of the topics. Profiles of 10 ordinary people with environmental careers help to personalize environmental science and present realistic job options for students. The chapters are supported by an adequate glossary and lists of Internet Web sites and recent literature references for further information.

One of the major themes in the text is the development of critical thinking (*i.e.*, deliberate, reason-based thought), which enables students to evaluate information and options in a systematic, purposeful, and efficient manner. The authors want students to be aware of hidden motives and assumptions, to uncover bias, and to recognize the reliability or unreliability of sources. "What do you think?" sidebars help to foster critical thinking by presenting the issues such as market-based incentives for environmental protection,

economic impacts of the Endangered Species Act, reasoned judgements and scientific uncertainty, and evaluating extremist claims. Questions for critical thinking are presented at the end of each chapter.

Although the authors have a good grasp of current environmental issues and the scientific aspects of environmental protection, their presentation of the legal and regulatory aspects is weak. They have overlooked public health as a conceptual basis for environmental protection in this country. Environmental statutes and regulations have been justified by epidemiological evidence demonstrating the link between human health effects and pollution levels. This edition of the textbook had 150 reviewers, but it should have been reviewed by individuals who are familiar with the regulatory framework of environmental protection. If students do not understand this framework, their ability to develop solutions to environmental problems will be diminished.

Overlooking this framework has produced omissions and factual errors. Chapter 18's discussion of air pollution mentions health effects, National Ambient Air Quality Standards (NAAQS), and air pollution control technologies. However, it ignores the air quality criteria documents that link health effects to NAAQS and ignores the state implementation plans that link the NAAQS to emission control regulations. The table of NAAQS includes, incorrectly, a standard for total suspended particulates, which was replaced in 1987 by a standard for inhalable particulate matter with a diameter of less than 10 micrometers (PM_{10}). The text states, incorrectly, that Congress approved revised NAAQS for ozone and respirable particulate matter ($PM_{2.5}$) in 1997. In fact, a lawsuit by the American Lung Association forced EPA to promulgate these standards, which continue to be opposed by many in Congress. The statement that California has gone further than the Federal government in making specific plans for air pollution control ignores the fact that the States, rather than the Federal government, have the responsibility for developing and implementing emission control regulations for existing air pollution sources.

The authors appear to have a conscious or unconscious ideological bias, which is inappropriate in a science textbook. Environmentalists are portrayed as wearing white hats, while industries, state and local governments, farmers, and land developers are portrayed as wearing black hats. Walt Kelly's famous Pogo comic strip for Earth Day 1971 produced the motto, "We have met the enemy and he is us". This book should have more of Pogo's perspective because it seems to place responsibility for environmental problems on someone else's shoulders, rather than our own shoulders.

This bias will hinder students from developing the balanced viewpoint of environmental issues that is necessary for critical thinking. It is most obvious in Chapter 25, which concerns what students can do in response to the information presented in the preceding 24 chapters. Student environmental groups, mainline environmental organizations, and radical environmental groups are discussed as options for students, but opposing viewpoints are lumped together under "antienvironmental backlash" without much distinction between moderate and radical elements. The tactics of various environmental groups are considered as a topic for ethical discussion while those of opponents are condemned. Contrast the tone of two of the chapter's questions for review:

- 1) Describe and evaluate the tactics used by radical environmental groups. Do you subscribe to monkey wrenching?
- 2) Describe the goals and tactics of the antienvironmental wise use groups. In what ways are their claims extremist?"

One questions whether monkey wrenching (*i.e.*, sabotage) and other drastic actions to protect nature are any more just than the same actions to protect one's property and livelihood. Do such actions support or undermine the efforts of others who have similar

concerns, but use more conventional actions? Do the results of drastic actions include weakening civil society in general? Substituting "civil rights" and "abortion" for "environment" in the above review questions may yield useful insights. The ethical dimension of this discussion extends farther than the authors portray.

The profiled individuals range from an environmental activist through a consulting engineer to an aquatic biologist at a trout hatchery. The only public servants that are profiled are an interpretive specialist at a National Forest and an environmental educator at a state natural resources conservation commission. None of the profiled individuals work for industry or perform regulatory duties. Inclusion of profiles of people working these fields would provide more balance and would present a broader range of potential environmental careers. Unfortunately, the authors denigrate public service by faint praise:

"...These administrative agencies represent a tremendous bureaucracy, which often is ponderous and unresponsive, but then, we have a big country, and running it is a big job. For the most part, our civil service is made up of dedicated, professional people..."

These agencies need committed individuals who can bring a broad understanding of environmental science and related disciplines to the narrow regulatory issues that they must deal with every day. These individuals can have a direct impact on the development and implementation environmental protection.

In summary, *Environmental Science: A Global Concern* provides useful scientific information for understanding complex environmental issues such as the Neuse River problem. However, it provides weaker information about the corresponding economic, legal, regulatory, and political issues. Its ideological bias will hinder the development of critical thinking in students.

ROBERT S. WRIGHT, *Center for Environmental Measurements and Quality Assurance, Research Triangle Institute, Research Triangle Park, NC 27709-2194.*

Note: The views and opinions expressed in this review are those of the author only and were provided in his individual capacity.

Ernst, C.H. 1999. **Venomous Reptiles of North America**. Paperback reissue of the original case-bound edition of 1992. Smithsonian Institution Press, Washington and London. \$29.95. iv + 236 pp. + 5 color plates.

This book leaves virtually no stone unturned in covering the poisonous snakes and the one poisonous lizard of the United States and Canada (North America, to the biologist, is U.S. and Canada, whereas the other countries of the continent are Mexico as Middle America and the others as Central America). Each species is covered in format with recognition, karyotype and fossil record, distribution, geographic variation, confusing species, habitat, behavior, reproduction, growth and longevity, food and feeding, venom and bites, predators and defense, populations, and remarks. An extensive literature cited (erroneously called bibliography) is included, as well as a key to the species and maps of, the distribution of each species. Some species are shown as black and white photos in addition to the color plates. It also contains a glossary for pronunciation of scientific names. Except that the book is complete only through 1991 citations, one could hardly ask for a more complete warehouse of information of the knowledge of the species considered. Much more literature has appeared and information from major contributions such as William Brown's, 1993 SSAR publication on the Timber Rattlesnake, *Crotalus horridus*, are bypassed by failure to update the reprinting. The two columns per page printing format

makes for easy reading.

Dr. Ernst fails to state in his opening remarks the audience for whom the book is intended. He mentions Gila Monster before he even tells that it is a lizard. Clearly the book is very useful for the professional herpetologist and well informed amateurs, but for the lay public it can be a challenge because of terminology. Sometimes Ernst introduces terms well before he defines them, and in any case a glossary of terms would be useful to the less informed reader. Discussions of temporal openings, e.g., may well be meaningless to the informed amateur whose real forte is collecting and breeding reptiles.

Some of the errors and inadequacies that I noted include: use of term anal plate for the scale that covers the cloaca and thus should really be called cloacal scute or scale. On p. 6 his referral to the hemipenis fails to note that the lizards and snakes have two hemipenes. On p. 8 he states that venom is saliva but fails to tell the reader that the poison glands are modified salivary glands. Fig. 3 shows the pit of pit vipers as the loreal: loreal is actually a scale. He speaks of intersupraoculars but no such is shown in any of his illustrations of the snake head. On p. 54 he says most colubrids lack the facial pit; I know of no colubrid that has a pit. On p. 107 under populations, he compares density per hectare of Sidewinder Rattlesnakes, giving values by Brown and Secor, but Secor's article never mentions density and I suspect that Brown's figure (in a dissertation) might be 0.1 rather than 1/ha. The statement on p. 177 under populations says that Johnson (1983) does not believe that the Ridgenose Rattlesnake is currently threatened; past tense "said" would be more appropriate.

So what more could we ask for? The original edition was reviewed for ASB; I have not seen that review and do not know what flaws might have been noted. This paperback version is relatively typo free but I noted several miscues and wonder why they were not corrected. Certainly in this day of manuscripts that can be printed from floppy discs, alterations are very simple to make. I am unhappy with some of the color plates that give poor color rendition, especially with a plate of the Gila Monster that has a total bluish cast to it and thus is far off on the color of both animal and background. Some of the maps might be questionable; even by 1990 the Massasauga, *Sistrurus catenatus*, was considered to be an isolated relict in Colorado and present day distribution in Nebraska seems to be restricted to the extreme SE corner of that state. (I, with tongue in cheek, in a 1996 article dealing with the Stephen Long Expedition, indicated that the expedition account, much done from memory, indicated that the species occurred across much of middle Nebraska but may have been confused with the Prairie Rattlesnake, *Crotalus viridis*, that was the normal associate in Prairie Dog towns). I also note that both the Canebrake Rattlesnake, *Crotalus horridus*, and the Copperhead, *Agkistrodon contortrix*, are shown all the way down to the coast of Louisiana. Hardly true that the two species occur throughout the marshlands. But, of course, very few range maps are true; they cover a whole region, but the species may occur only scattered in suitable habitats. The maps show only distribution to the U.S.-Mexican border; a full range distribution that includes Mexico would give a better feel for understanding the animals.

I do feel a little squeamish about Ernst's English usage. He uses the indefinite "it" and the likewise indefinite "there is/are" and he improperly uses "compare to" rather than "compare with", a sometimes rather subtle difference. And, finally, in applying common names, he may utilize the often misused adjectival form, e.g., Ridgenose Rattlesnake rather than Ridgenosed Rattlesnake.

But in all fairness, I must say that no book is perfect and the tremendous amount of information imparted by Ernst is a most valuable resource that I would unhesitatingly recommend for all herpetological bookshelves. The real shame is that it is a reprint of an earlier edition without an update or cleanup.

HAROLD A. DUNDEE, *Tulane University-Museum of Natural History, Belle Chasse, LA 700.37-3098*. E-mail dundee@museum.tulane.edu

Gotelli, N.J. and G.R. Graves. 1996. **Null Models in Ecology**. Smiths. Inst. Press 368 pp. \$65 cloth, \$36 paper.

This book presents the Tallahassee perspective on null models in ecology, specifically, randomization tests for patterns in community ecology. Chapters review previous work on diversity and abundance, size ratios and niches, co-occurrence, species area and biogeography, and food webs, and each chapter concludes with a paragraph of recommendations. The preface notes that one's opinion of this book may be determined by one's prejudices for or against this form of -11 models. As a proponent of informed use of randomization tests, I find this book a good index to much of this literature, but inadequate as both a synthesis of lessons learned and as a guide to future applications of null models.

The traditional statistical concepts of null hypotheses are outside the aims of this book, yet it suffers from a lack of statistical theory at several levels. There are minor shortcomings: for example the introductory philosophical chapter claims that the failure to reject a null model is grounds for concluding that a mechanism is not operating; lack of statistical power is mentioned only as a property of "flawed" null models, not of inadequate sample sizes. More seriously, the theoretical concepts of sufficient and ancillary statistics and the conditionality of tests could provide a framework for assessing the validity of randomization tests.

Null models should include the effects of all factors except the factor of interest, for example differences in vagility and population density and habitat requirements and source populations but not competition. Unfortunately, randomization tests conditioned on the observed data are null models of sampling processes, not directly of ecological processes, and this book does not make the distinction clear. A null model of ecological processes A, B, and C but not D usually does not directly map onto a sampling null model of constraints 1,2, and 3 but not 4. My sense is that for null models ranging from rarefaction curves to size ratios to coexistence, the connection between the null ecological factor model and the null sampling model determines the validity of any null model approach. It is difficult to specify correctly the appropriate randomization or bootstrap for complicated sampling problems; it is not always possible to tie a biological process to a sampling process.

Instead of such a conceptual framework, each chapter provides a collection of null models, specific criticisms of each and occasional rejoinders, and then rather facile prescriptions of specific techniques or approaches. For example, rarefaction curves and hypergeometric confidence intervals about them are presented as the be-all and end-all of diversity measures. This may be true enough for studies of vertebrates and vagile animals but is not true for vegetation, and both this distinction and the reason for the distinction are omitted. The "null mode" of independent and equiprobable sampling of individuals is inappropriate for vegetation sampling (and questionable for the original Sanders benthic sampling) based on quadrats rather than individuals. This problem is addressed only obliquely in terms of randomness of the spatial distribution of individuals, and the recommendation is to treat the individuals as spatially random and thus

independently sampled “unless a great deal of information is available on the spatial organization of the assemblage” (p. 28). Valid scale-dependent approaches to plant diversity exist, yet the reader is neither explicitly warned of the differences for plants versus animals nor pointed in the right direction. Similarly, for species co-occurrences, Jackson *et al.* (1992) is cited in another context, but its randomization procedures are ignored and a new procedure is recommended. The new procedure may or may not be better, more likely the differences between the two approaches make them more suitable to slightly different situations or questions, but the reader is afforded neither the tools nor the facts with which to judge.

More contentious applications such as species co-occurrence are covered in a rather incomplete manner. A reader should beware: such topics do not yet lend themselves to unbiased accounts, especially when presented anecdotally rather than in an analytical framework. The biases of Gotelli and Graves differ from mine.

TOM PHILIPPI, *Savannah River Ecology Laboratory, Drawer E, Aiken, SC 29802.*

Hopkins, William C. 1998. **Introduction to Plant Physiology.** J. Wiley & Sons. New York, NY. 2nd ed. 512 pp. \$97.95.

The colorful cover of *Introduction to Plant Physiology*, 2nd edition by William Hopkins certainly attracts the eye and stands out on the shelf. But in the hands of the upperclassman, not on the shelf, is where this book should be. Overall, it is a lucid treatment of the physiology of plants for the newcomer who has by now become familiar with the way this subject matter is partitioned, namely into the plant processes such as transpiration, nutrition, photosynthesis, hormones, *etc.* Thus, the traditional Professor of Physiology will feel very comfortable with the layout. It starts out with a review in the basics of cell biology, biochemistry, and plant anatomy. The book next covers whole plant physiology followed by plant-unique processes such as carbon metabolism, plant hormones, and tropisms. Writing is straight-forward and the information not too dense for the intended clientele. The use of topic boxes to segregate specific issues fills in for the lack of depth in the body which often overwhelms the anxious upperclassman while still providing it within perspective. These topic boxes also provide some of the names of the history makers in this field but unfortunately, the faces and the anecdotes of their science have been left out. One finds the standard review exercises and suggested references at the end of each section.

Dr. Hopkins attempts to integrate our understanding of the physiology of plants by bringing in close proximity different aspects of plant biology. For example, in the discussion of water movement, one can find critical information on the anatomy of the cellular conduits and in the discussion on energy, one finds nearby a discussion of chloroplast biogenesis and stomatal anatomy. But this critic feels that this level of integration is not enough in these times. The discipline of plant physiology has evolved greatly in the last two decades. While we still seek an understanding of the physiology of plants, asking the same kinds of questions, the means we do so now incorporates a wider group of scientists including geneticists, cell biologists, developmental biologists, and functional genomicists. For example, the book could be improved greatly by discussing the major advances in our understanding of all the traditional processes from the geneticist's viewpoint. Mutants, especially using *Arabidopsis*, have provided some answers that have not been tractable by the traditional physiologist's approach. Hormones really should no longer be treated as a “topic” to which chapters are devoted, but woven within the discussion of physiology. The distinction between plant development and physiology has also blurred over the decade,

thus should not be treated separately. Plant development, for example, should be treated in a separate chapter (chapt. 15) but rather throughout the book.

At the current speed of research, it must be very hard to print a textbook up to date with the science. Nonetheless, there have been major advances in our understanding of the physiology of plants since the first edition and the omission of these findings, which were brought mainly by forward and reverse genetic approaches, is blatant. For the same reason, it must be equally hard to project into the future of plant physiology. One way to safely attempt this is by discussion of the present and placing the physiologist into perspective of other sciences. For example, how will our understanding of plant physiology impact our understanding of human physiology? An introduction of plant metabolites (chapt. 14), for example, should have called immediately for its impact on humans rather than implying it in the last chapter (chapt. 23). What metabolites are used in medicine and agriculture, how and why will plants be used as bioreactors, how can plant genomics impact society, etc.? These criticisms of the textbook are unfairly harsh since the task of real integration of plant physiology is daunting and may be impossible for the student being introduced to plant physiology.

All said, this critic finds that Dr. Hopkins's book serves as a reasonable backbone to any introductory plant physiology course and does more to integrate the sciences than many other competing texts. However, the truly enlightened professor will want to embellish the course with other material and attempt to take Dr. Hopkins's effort to integrate and synthesize much further.

ALAN JONES, *Department of Biology, University of North Carolina at Chapel Hill, NC.*

Isler, Morton L., and Phyllis R. Isler. 1999. The Tanagers: Natural History, Distribution, and Identification. Smithsonian Institution Press, Washington, D. C. \$39.95 paperback. 406 pp.

For many people, the emblem of tropical nature is a gaudily colored bird. Actually most tropical birds are so drab and indistinct that taxonomists must work hard to sort them out. Nevertheless, certain taxonomic families of birds do epitomize our ideals of the tropics. Perhaps the preeminent example is the tanagers.

Entirely restricted to the New World, tanagers comprise some 242 species, all but a handful confined to the Neotropics. This paperback edition, with corrections, of the Islers' recent, but already classic, treatise on tanagers has all of the spectacular plates of the original edition. The array of color is astonishing, as evidenced by the English names of some of the species: Paradise Tanager, Seven-colored Tanager, Multicolored Tanager, Grass-green Tanager, and, of course, Scarlet Tanager. It is amazing that a bird so brilliant as our familiar Scarlet Tanager (which nests in eastern North America but retires to Amazonia for the winter) can become just one of the gang when set amongst all of its tropical relatives!

The Islers' book is a classic, not only for the illustrations, but also for the comprehensive text. Virtually everything known about tanagers is summarized here, including plumages, measurements (including weights), geographic and elevational ranges, habits and behavior, vocalizations, and breeding. Species like the Scarlet Tanager, that migrate long distances, merit two sections -- one presenting information for the breeding season and the other for the nonbreeding season. Each account has a complete bibliography, as well as citations of original sources in museums or collections of wildlife sounds.

Although birds in general are among the best known of the major groups of animals and over 300 pages are needed to summarize current knowledge of tanagers, a book like this

one is bound to reveal how little we actually do know. As one of the major groups of fruit-dispersing birds in tropical forests, tanagers must play an integral role in the dynamics of tropical ecosystems. The genus *Euphonia* has evolved mutualistic relationships with a genus of mistletoes *Phoradendron*. Yet we know only a few tantalizing tidbits about the biology of these and other tanagers.

Tanagers also pose some difficult problems for conservation. Many have restricted ranges in the Andes or in eastern Brazil, in areas where forests are now under intense pressure from expanding human populations. The North American species, on the other hand, exemplify the problems of many Neotropical migrants. If nothing else, this book brings home what spectacular biodiversity we will lose if we do not plan for the conservation of tropical ecosystems.

This classic thus provides a treat for biologists at any level: an identification guide and introduction for birders and ecotourists; a summary of current knowledge for the ornithologist; and an incentive for us all to act before it is too late.

R. HAVEN WILEY, *Department of Biology, University of North Carolina, Chapel Hill, NC 27599-3280.*

Parmalee, Paul W. and Arthur E. Bogan, 1998. The Freshwater Mussels of Tennessee. The University of Tennessee Press, Knoxville, TN \$50.00. 344 p.

Freshwater mussel taxa reach their greatest diversity and numbers in southeastern North America. Of approximately 300 freshwater mussel species recorded from North America, about 130 are known to have occurred in Tennessee waters. In the 1930 and 1950's many of the Tennessee freshwater habitats were impacted by dam construction, altering and frequently destroying the mussel faunas with about half becoming endangered or extinct. This is the first book to describe and document the freshwater mussel fauna of Tennessee. Nine color or black/white figures, 3 tables, 130 range maps, and 133 color plates are included.

As identification of freshwater mussels has been, and continues to be, difficult and confusing, this book on the mussels of Tennessee is an important taxonomic and ecological reference to anyone interested in freshwater mussels within North American waters. Lavish use of colored illustrations serves to heighten educational and non-scientific interests.

Ecology and water quality characteristics of freshwater habitats can be dependent upon existent Mollusca. Land use practices of man, in particular dam construction, farming and lumbering practices, and industrial discharges continue to adversely affect mussel populations. Commercial use of some species and recent invasion by several competing bivalve species also contribute to such. The result is that of the approximately 300 species known from North American fresh waters, over half are now listed federally or by states as threatened, endangered, of special concern, or extinct.

The Preface states that the book is written so as "to provide the reader with a concise treatment of each taxon, including a written description of the shell with accompanying color photographs of two 'typical' specimens of each species, that will enable its identification", plus historic synonymy, general Tennessee distribution records, notes on life histories, ecology, host fish, and endangered status. Numerous persons who contributed to the making of the book are listed under acknowledgments. They include collectors, industrial users of freshwater mussels, and numerous scientific and non-scientific persons.

This book is divided into two major sections: *Mussels and Malacology in Tennessee* and

Accounts of Species. The first section includes the following chapters: Introduction; Structure, Development, and Growth; Taxonomy, Classification, and Common Names; A Brief History of the Classification of North American Freshwater Mussels; Ecology of Freshwater Mussels; The Unionoid Faunal Provinces of North America; Diversity of River Systems and Their Naiad Faunas; Aboriginal Exploitation of Freshwater Mussels; Historic Exploitation of Freshwater Mussels; Factors in Determining Distribution Records; and Translocation: An Answer to Species Survival? The Introduction states that 171 [161?] taxa of native freshwater bivalves, first discovered in the early 1800's, have been identified from Tennessee waters, which include drainages from the Tennessee, Cumberland and Mississippi Rivers. Subsequent published works on this fauna are discussed. The chapter on Structure, *et al.*, contains a general overview of mussel soft-part anatomy, shell structure, habitat, ecology and life cycles. Colored illustrations include a nice series of photographs of shell deformities.

Freshwater bivalve classification used in this book is discussed in the next chapter. Scientific and common names follow Turgeon *et al.* (1988) and Turgeon *et al. n.d.*, except where the authors believe otherwise. Several tables are included in this chapter: the first lists the higher taxa of Tennessee bivalves; the second, scientific and common names for all Tennessee occurring bivalves plus state and federal status of each. One Margaritiferidae, 133 Unionidae, one Corbiculidae, 14 Sphaeriidae (Fingernail clams), and two Dreissenidae are listed (species [taxa] accounts do not include the Sphaeriidae).

The history section on classification of North American freshwater mussels relative to the Rafinesque and the Ortmann schools of freshwater mussel taxonomy is excellent - the authors leaning towards Ortmann. Differences between these schools of thought have led to considerable taxonomic confusion within this century (reviewer opinion). The authors do discuss modern ecological and biochemical findings influencing present day freshwater mussel systematics..

The general ecology section seems slanted towards the harmful effects by dams and human land use practices. Freshwater mussel commensals, parasites and predators are discussed. An interesting quote from Apgar (1887) is included relative to how muskrats feed on mussels. Twelve faunal provinces of North America, as characterized by the authors for terrestrial gastropods but subsequently modified for unionoid bivalves, are defined, and discussed.

In the section relative to diversity of river systems, the authors divide the freshwater drainages of Tennessee into four major river systems: Mississippi, Tennessee, Cumberland, and Coosa (Conasouga). Freshwater mussel taxa found in each system are listed in a table. Physical habitats and naiad diversity within each are discussed.

The chapter on aboriginal exploitation describes and discusses mussel accumulations from Tennessee "middens". Use of freshwater mussels as a food resource is examined by the authors and an entertaining account is included of attempts to eat such mussels written by a Pvt. Watkins, Company H, First Tennessee Regiment (Civil War period). The section is concluded with descriptions and illustrations in color of mussel shell use by early native North Americans for tools, utensils, and ornaments.

Tennessee freshwater mussel pearl industries are described and their commercial value approximated. Their historical records, tools, and culturing techniques are colorfully illustrated. The reviewer was struck with how close their methods for sorting commercial-sized shell from meats, sand and small shell are similar to recent automated Calico Scallop shucking equipment developed in North Carolina. Complexities in summarizing Tennessee distributional records are discussed and distributional maps are included with each taxa account.

The last topic in this section contains a summary of attempts to save freshwater mussels of "Endangered" or "Special Concern" status from becoming extinct. The authors

believe that translocation, habitat reclamation, research on artificial propagation, *etc.* may assure that many of the Tennessee freshwater mussel taxa will survive into the twenty-first century.

The second section of this book, *Accounts of Species*, includes 134 freshwater mussel taxa accounts and three non-Unionoid bivalves, several being recent invaders to Tennessee waters. Each account includes the following: Scientific name, Common name, Range map, Plate, Synonymy, Type locality, General distribution, Tennessee distribution, Description, Life history and ecology, and Status. Each plate contains colored photographs of two differing specimens, the upper photo is a right view and the lower is a left view. Photos generally show hinge structure of the opposing valve.

An additional ten taxa (subspecies and forms) are discussed; photographs or range maps were not included. A Glossary, Literature Cited, and an Index are included at the book's end.

This book is an excellent reference to freshwater habitats, mussel systematics, and the fauna of Tennessee. It is well illustrated and worth its price. Few errors were noted which is surprising in a first edition. A minor criticism is the absence of taxa accounts for the Fingernail Clams (Sphaeriidae); regrettable, as these could be most important in freshwater ecological studies. This family continues to be largely overlooked in many freshwater surveys.

HUGH J. PORTER, Mollusk Curator, *University of North Carolina at Chapel Hill, NC, Institute of Marine Sciences. Morehead City, NC 28557*

Sumich, J.L. 1999. **An Introduction to the Biology of Marine Life**. 7th ed. McG-Hill Co., New York, NY \$47.50. 484 p.

Sumich's Introduction to the Biology of Marine Life is written to serve as an introductory college-level course. However, I feel it would be better used as a senior high school level text. The preface states that supplementary material such as: Instructor's manual/text, slide set, transparencies, micro Test 111, student study guide, laboratory manual, and video tapes are available as excellent complements to the text and lecture. This reviewer saw none of these and can't attest to their value.

Sumich's 7th edition would make a high school rather than college level text as it tries to cover all things, alas meant well, all too briefly. Sixteen chapters encompass this volume: ocean as a habitat; ecological and biological concepts; marine primary producers; marine plants; primary production in the seas; proto-arts and invertebrates; marine vertebrates; the intertidal; estuaries; coral reefs; below the tides; zooplankton; nekton-distribution, locomotion and feeding; nekton-migration, sensory reception and reproduction; human food from the sea, and ocean pollution. Three appendices, selected references, glossary, taxonomic and general indices complete the volume. "Research progress," pages of varying lengths, are interspersed in each chapter. Their inclusion interrupts one's reading of the chapter and would have been best either at the beginning or end of a chapter. Summary points, review and challenge questions, and suggestions for further reading and internet addresses complete each chapter. One has to go to each chapter's additional reference list, at the back of the book, to seek more information on the chapter's subject matter. Fourteen valuable pages noting internet addresses should have been deleted and/or used to add additional updated references.

My strongest criticism of the book is of the suggested articles and books at the end of each chapter, as well as the selected references in Appendix C (p. 458-467). Most are outdated. I find only four references to papers or books published after 1990, one in 1997.

The rest, while good, are 1950's to 1980's references. The author seems to have looked only at American Scientist, Scientific American, Oceanus, Bioscience, *etc.*, all good sources that usually have review articles, to the exclusion of in-depth papers in the scientific literature. Biosis and Zoological Record (bibles to research scientists) are nowhere to be noted as a source to seek additional updated information. Many important articles and books have been missed, *i.e.*, Dayton's, Faces of the Deep; Kohlmeyer's, Marine Fungi of the World; Jefferson *et al.* FAO, Marine Mammals of the World; J. Nelson's, Fishes of the World; Helfman *et al.*, Diversity of fishes; Williams *et al.*, Venomous and poisonous animals, and a host of other references. Important items such as endangered species, responses to depth by the eye or body, effects of pressure on deep sea fishes, diadromous migration, or protandry are not treated. No mention is made that some sea turtles can hold their breath for up to 18 hours. *Carcharias* is misspelled on p. 398. Most line drawings are poor depictions of the species they are supposed to depict. Within the reference cited section, many are repeats (*i.e.*, Smith and Jackson 1986, Chapt. 3, Chapt. 4). *etc.*

Thus, it seems the text may have been added to and/or updated during each edition but the above distract from the volumes' overall value. It would have been better to delete the web pages, use the entire width of a page rather than two-thirds of the width, organize the references into one overall list at the end and not try to assemble so much in a well-meaning way that it winds up giving one only bits and pieces instead. The book does wonders for the general science or high school reader. They will find much in one volume, but for the college student it will only whet his appetite and leave him unfulfilled as he will find dated references and material or no detail references which he can sink his teeth into. For the money, neither student will lose out. There is much more they can learn, if directed to the vast available marine literature and information.

FRANK J. SCHWARTZ, Institute of Marine Science, *University of North Carolina, Morehead City, NC 28557-3209.*

Turchin, Peter. 1998. **Quantitative Analysis of Movement: Measuring and Modeling Population Redistribution in Animals and Plants.** Sinauer Associates, Inc. Publishers, Sunderland, MA 10375. \$38.95 paper, 348p.

By virtue of its scope and stated primary goal, this book is currently *the* source, in quantitative analysis of movement as it provides complete descriptions and the systematic quantitative methods used in analyzing and modeling movements of organisms in the field. As such, it overcomes the impediments to a theoretical-empirical synthesis in the field of spatial ecology. Secondary goals of the book are to "provide a popular account of the mathematical aspects of movement models relevant to ecologists, and to stimulate ecologists to test their theoretical approaches and models in the field." As the author states near the beginning, "read chapter 5 before going in the field." Chapter 5 focuses on three themes: inferring rates of population spread from individual-based data; quantifying effects of spatial heterogeneity on individual movements and population redistribution, and measuring effects of long-distance attraction. All too often many ecological researchers and students go into the field with the intent of collecting the world, and end up with too much data that is not warranted or required. The author is quite clear about the targeted audience for his book "written primarily for active researchers and graduate students interested in spatial ecology, including application in conservation ecology, pest control, and fisheries.

The book is divided into seven chapters titled: Why study movement? Data for measuring movement; Modeling movement; Building behaviorally based models; Analysis

of movement paths; Mass mark-recapture; and Individual mark-recapture. Four additional sections are provided: a hefty appendix on diffusion for ecologists, a 35-page bibliography, glossary, common symbols, and index. This soft covered 396-page book, with an attractive cover depicting flight trajectories of male fireflies, is punctuated with seven relevant tables, 46 well conceived, clear, and informative figures, and five boxes of derivations of formulae. It is plainly written even for those not familiar with the subject matter. Not for the mathematically faint of heart when it comes to equations (in fact, Turchin suggests collaborating with a mathematician), Turchin has made mathematical modeling accessible to those without majors in calculus. Personally, reading this book has opened a new level of analysis, for my own research of movement among pebble nest-building cyprinid fishes and the hoards of nests associates (*i.e.* species that may congregate and aggregate over nests but do not contribute to its construction) over spawning nests.

Eugene G. Maurakis, *Science Museum of Virginia, Richmond, VA 23220 and University of Richmond, VA 23173.*



Dr. Edward O. Wilson gives the plenary address

NEWS OF BIOLOGY IN THE SOUTHEAST

Jon R. Fortman-News Editor
Division of Science and Math
Mississippi University for Women
Columbus, MS 39701

ABOUT PEOPLE AND PLACES

GEORGIA

Agnes Scott College, Department of Biology. The Board of Trustees has given approval for a \$37 million addition to and renovation of the Campbell Science Hall and Bradley Observatory at Agnes Scott College. The anticipated completion date is July 1, 2002 for the Science Hall, and summer of 2000 for the Bradley Observatory. In addition, the college has added a new faculty position in Molecular Biology and Genetics. *Dr. Timothy Fincol*, Assistant Professor of Biology, joined the faculty in the Fall 1999. He has a Ph.D. from the **University of North Carolina at Chapel Hill** and has been a postdoctoral fellow at the University of California San Francisco School of Medicine for the past three years. The Department was honored by one of its majors, *Candace Lyn Perry* of Philadelphia, Mississippi, who was named one of 330 Barry M. Goldwater scholars. Another major, *Amelia Tomlinson*, in conjunction with *Dr. Phil Gibson*, was recognized at the 1998 conference of Beta Beta Beta in San Diego, as having the best poster at the meeting.

MISSISSIPPI

Delta State University, Department of Biological Science. *W. Wayne Walley*, Ph.D. retired June 30, 1999 as Professor and Chair of the Department after twenty years in the position. He was awarded Professor and Chair Emeritus status and will continue to serve the department on a part-time basis. *Dr. Nina Baghai Riding* has joined the department as Assistant Professor of Biological and Environmental Sciences. Her previous appointment was at Black Hills State University in Spearfish, SD. *Dr. Riding* received her Ph.D. in botany from the University of Texas, Austin. *Dr. Barry Campbell* is also new to the department. He is an Assistant Professor of Biological Sciences, and came from Edgewood College and Madison Area Technical College in Madison, WI. His Ph.D. is in parasitology from **Tulane University**.

University of Mississippi, Department of Biology. *Dr. Stephen T. Threlkeld*, Professor, has been appointed managing editor of *Estuaries*. Beginning this past spring, the editorial offices for the journal will be located in the Department. *Dr. Rebecca L. Holberton* was promoted to Associate Professor of Biology. *Dr. Clifford Ochs*, Assistant Professor, has been appointed Director of Graduate Studies for the Department of Biology. Inquiries regarding the masters and doctoral program may be directed to him at byochs@oldmiss.edu. *Dr. Gary L. Miller*, Professor and Chair, and *Dr. Robert E. Ricklefs (Univ. of Missouri, St. Louis)* have published *Ecology*, 4th ed. *Dr. Gary Gaston*, Professor, and *Dr. Larry Shaffer*, Acting Assistant Professor, taught the first courses this summer in a new teaching program conducted by the Department in Belize. In coming summers, four to six courses will be taught in Belize by department faculty. *Dr. Rebecca L. Holberton* was selected as this year's Distinguished Teacher in the College of Liberal Arts, one of only two awards given by the College each year in recognition of teaching. The Herbarium was officially dedicated to its first curator in a ceremony in Oxford on April 16,

1999. The Thomas M. Pullen Herbarium is a collection of over 61,000 vascular plants, mostly from Mississippi and the southeastern United States. The curator, *Dr. Lucile McCook*, welcomes loan requests and visitors to utilize the facility.

NORTH CAROLINA

Appalachian State University Department of Biology. *Dr. Vicki Martin* has been named department chair. *Dr. Martin* comes from the faculty at the University of Notre Dame. She received her Ph.D. from ***Wake Forest University***. *Dr. Martin* replaces *Dr. Richard Henson* who has been acting chair. *Dr. Henson* will take the position of Assistant Dean of Arts and Sciences.

TENNESSEE

Middle Tennessee State University, Department of Biology. *Dr. Brian Miller*, in addition to being promoted to Professor and publishing papers in *Herpetological Review* and *Herpetological Natural History*, is in the third year of a four year \$64,640 Nature Conservancy grant. *Dr. Amy Jetton* was promoted to Associate Professor with tenure. *Dr. Jetton* and *Dr. Alice Mills*, received a \$92,840 Instructional Laboratory Instrumentation Grant from NSF. *Dr. Steve Howard* was promoted to Associate Professor with tenure. *Dr. Frank Bailey* has been promoted to Associate Professor with tenure. *Dr. Bailey* is a reviewer for *Archives of Environmental Contamination and Toxicology*, and is Vice-President, Mid-South Chapter, Society of Environmental Toxicology and Chemistry. *Dr. Keith Walters* received tenure and serves as a reviewer for the *J. Linnean Soc. of London*, *Marine Ecology Progress Series* and NSF Proposals. *Dr. Deborah Clark* received the MTSU Innovative Excellence in Teaching, Learning, and Technology award. *Dr. Clark* authored a *Student Study Guide* to accompany *Principles of Genetics* by R. Tamarin. She and *Dr. Philip Mathis* co-authored, *Genetic Investigations for the Laboratory*, 2nd ed. *Dr. Gore Ervin*, has been elected the Managing Editor of the Tennessee Academy of Science. *Drs. Anthony Newsome* and *Anthony Farone* has received a \$131,000 grant from EPA to investigate the Environmental Distribution and Disease Potential of New Legionella-like Bacteria as a Function of Environmental Variables. *Dr. Newsome* previously received a \$118,000 EPA grant to study Protozoa in Risk Assessment of Legionellosis - Inadequacy of Guidelines and Monitoring. *Dr. Farone* received a teaching award from the American Society for Virology and one of his students, *Chad Brooks*, was awarded a \$700 Sigma Xi Research Grant. *Dr. Cindi Smith-Walters* was awarded \$55,000 in grants from the State and EPA to do Teachers Education Workshops on Solid Waste and Water Quality. She was also named the Higher Education Science Teacher of the Year by the Tennessee Science Teacher Association. *Dr. Philip Mathis* and *Dr. Debra Clark* along with others, put together *Scientia* an electronic journal (<http://www.mtsu.edu/~scientia>) that will feature scientific and technological research of MTSU students. *Dr. Mathis* also received the Society for College Science Teachers Outstanding Undergraduate Science Teaching Award.

MUSEUMS AND BOTANICAL GARDENS

FLORIDA

Marie Selby Botanical Gardens, Sarasota. At a recent 16th World Orchid Conference in Vancouver, Canada, Selby Gardens won three prestigious awards for its orchid conservation display. Some calendar events include 18th and 19th Century Nature Illustration from William Hartman and Selby Gardens Collections in October 1999. November 1999 the Gardens will host the Fall Plant Fair. Selby Gardens by Candlelight, in December, will have thousands of luminarias on a giant Bromeliad Tree.

MISSISSIPPI

Museum of Natural Science, Jackson. Some summer events for 1999 were "snake day" and "pathway to fishing". *Howard Miller*, Chairman of the State Commission on Wildlife, Fisheries and Parks, died April 1, 1999. He served on the Museum's foundation Board of Directors from 1986-1990.



Officers of the Association of Southeastern Biologists. Front row, from left: Pat Parr, Terry Richardson, Bonnie Kelly, Andy Ash, Gerhard Kalmus, and Pat Cox. Back row, from left: Joe Pollard, Eloise Carter, George Cline, Ken Shull, Tim Atkinson, Howard Neufeld and Dwayne Wise.



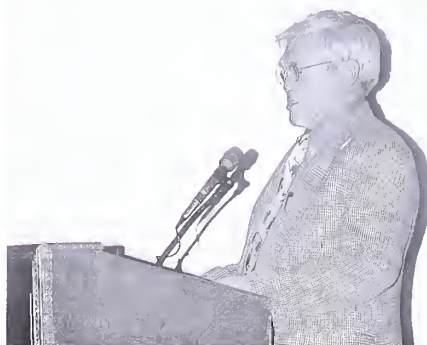
Ruth Douglas presents the Bartholomew Award to Dan Evans



Eloise Carter and John Herr



Pat Parr introduces E.O. Wilson



Whit Gibbons gives the
Past President's address

BETA BETA BETA ABSTRACTS

DISTRICT I PAPERS

ALBERT, MARIANNE E. University of South Carolina School of Medicine-
Molecular Cloning of Gene Sequences to Optimize In-Situ Hybridization.

Molecular cloning can be used to cleave vector DNA with a restriction enzyme and insert a specific gene sequence. In my research, plasmids were constructed that contained specific sequences. These sequences encoded for proteins in GABA_A receptors. The plasmids were used in in-situ hybridization to generate RNA probes that matched up with mRNA in regions of the rat brain with GABA receptors. Altering gene sequence size modified the expression of neurotransmitter receptors and neuropeptides. The probes from the longer-sequence original plasmid were associated with non-specific binding while those probes derived from the shorter-sequence final plasmid had more specific binding with mRNA and better background. Therefore, in-situ hybridization was optimized by the molecular cloning of shorter nucleotide sequences that were able to target mRNA without damaging the cell or tissue. With greater sensitivity and specificity in in-situ hybridization, gene expression can be studied with greater detail and accuracy.

Crisp, Jeremy. Erskine College—Synergistic Effects of Rifabutin and Amphotericin B Against *Aspergillus* In Vitro.

Many fatal infections among immunocompromised patients are the result of *Aspergillus*, a filamentous fungus. Patients who develop aspergillosis are treated with Amphotericin B, the gold standard, but with untoward side effects including fever, chills, hypotension, severe electrolyte imbalance, and nephrotoxicity. Rifabutin is an antimicrobial agent frequently used as prophylaxis and treatment against *Mycobacterium azium*. Its mechanism of action is the inhibition of DNA dependent RNA polymerase. This study combined these two drugs, *In Vitro*, to investigate the possibilities of any synergy they may exhibit against three clinically significant isolates of *Aspergillus*: *Aspergillus fumigatus*, *Aspergillus nidulans*, and *Aspergillus terreus*. The *In Vitro* experiments demonstrated promising results for the existence of synergy between Amphotericin B and Rifabutin against *Aspergillus*.

ELMORE, CHRISTOPHER F. University of North Carolina at Charlotte – Determining the order of action of MMA in relation to PKC in the inductive pathway of metamorphosis in the hydrozoan *Hydractinia symbiolongicarpus* (Cnidaria, Hydrozoa)

Metamorphosis in hydroids from a motile larva to a sessile polyp is initiated in nature by a bacterial product. Other agents, such as diacylglycerol (DAG) and cesium ions (Cs²⁺) can substitute for the bacterial product. Signal transduction has been shown to be mediated by a signal cascade involving protein kinase C (PKC). Two groups of investigators (Schneider and Leitz, 1994, and McCauley, 1997) have proposed that both DAG and Cs²⁺, both of which appear to have their action at the anterior end where sensory cells are located, act upstream of PKC activation. Both models propose that the cnidarian neuropeptide metamorphosin A (MMA), which can cause metamorphosis in isolated posterior ends, acts downstream of PKC activation. To test the models in the hydroid *Hydractinia symbiolongicarpus*, we treated larvae with DAG, Cs²⁺, and MMA in the presence and absence of the PKC inhibitor 1-(5-isoquinolinesulfonyl)-2-methylpiperazine (H-7). Surprisingly from the predictions of the models, H-7 prevented induction of metamorphosis by MMA, but did not significantly affect induction by DAG and Cs²⁺. Thus our results indicate that the two models proposed to date for the signal cascade leading to metamorphosis are not applicable to this species.

Fumi, Erica M. and J. Timothy Lightfoot. University of North Carolina Charlotte. A Strain Screening of Initial VO₂max in Inbred Mice.

Human studies have indicated that heredity is responsible for 40-94% of an individual's aerobic capacity. To our knowledge, there are no animal studies that have investigated the genetic basis for inherited aerobic capacity. Therefore, the purpose of this study was to measure aerobic capacity (VO₂max) in several inbred strains of mice as a foundation for future genetic studies. Eight, 8-9 week old mice in each of 5 inbred strains (AKR/J, C3H/HeJ, DBA/2j, C57Bl/bj, C57L/J) were tested. VO₂max (ml/kg/min) was measured using open circuit spirometry in a flow chamber mounted on a treadmill. The C57L/J strain had a significantly higher ($p < 0.0001$) VO₂max (131.2 ± 6.7 ml/min/kg, mean $\pm$ SE) than the other strains (AKR/J = 97.3 ± 4.1 ; C3H/HeJ = 112.7 ± 3.7 ; DBA/2j = 95.4 ± 5.0 ; C57Bl/bj = 110.5 ± 4.6). Further, the C57L/J strain exercised significantly longer (12.93 ± 0.18 mins; $p < 0.0001$) than the other strains (AKR/J = 6.21 ± 1.16 ; C3H/HeJ = 8.74 ± 0.90 ; DBA/2j = 5.85 ± 0.65 ; C57Bl/bj = 7.40 ± 0.90). From this data, it is obvious that at least one inbred strain of mice exhibits a significantly higher initial aerobic capacity suggesting some amount of genetic influence. This finding will provide at least one parental strain for future studies on the genetics of aerobic capacity.

Funding provided by the Beta Beta Beta Research Scholarship Foundation Fund and a UNC Charlotte Internal Research Grant.

Hartwell, Hadley J. The University of North Carolina at Charlotte – Comparisons of the hindlimb extensor muscle, *semimembranosus*, in the leopard frog, *Rana pipiens*, and the marine toad, *Bufo marinus*

The hindlimb hip extensor muscle, *Semimembranosus*, was isolated and stimulated in two species of anurans, the common leopard frog, *Rana pipiens*, and the marine toad, *Bufo marinus*. *R. pipiens* is an excellent hopper producing long, powerful jumps, while *B. marinus* produces shorter, weaker hops. Thus these two species represent extremes of hopping behavior in frogs and provide a good comparison to test muscle adaptation. I measured the basic contractile properties (force, contraction speed, and fatigability) of each whole muscle. Isometric twitch tension and tetanic tension contraction were elicited by direct nerve stimuli in a live animal preparation. Maximum forces as well as variation in force with changes in length, force frequency and force duration were determined. I also used standard histochemical methods (Putnam and Bennett, 1983) to identify and compare the muscle fiber types between *Rana* and *Bufo*. Results found statistical differences in the twitch contraction forces but contradictory results from the tetanic tensions. This suggests that there are differences in the mechanisms with which the fiber types are stimulated.

HJELMELAND, MARK D. Catawba College Department of Biology Salisbury, NC 28144—The Fractal Geometry of Dimorphism in the Yeast *Candida albicans*

The fungus *Candida albicans* causes opportunistic infections in humans. *C. albicans* virulence relates to its ability to switch between the invasive filamentous form and the yeast form. The yeast form produces circular colonies on agar plates, while the filamentous form produces irregular colonies. The filamentous colonies have characteristics of fractals, a mathematical measurement of irregularity. This study investigates the relationship between the fractal dimension, and the growth conditions. *Candida* is an anamorph of *Saccharomyces* so the growth patterns of *C. albicans* was compared to *Saccharomyces cerevisiae*. The fractal dimension of *C. albicans* on YPD, a complete medium, was 1.0173 ± 0.018881 , while *S. cerevisiae* was 1.00 ± 0.008595 . *C. albicans* dimension on SLAD, a nitrogen-limited medium, was 1.1012 ± 0.063738 , while *S. cerevisiae* dimension was 1.1135 ± 0.039883 . *C. albicans* dimension on media containing bovine serum was 1.1374 ± 0.09491 , while *S. cerevisiae* was 1.016 ± 0.032635 . On YPD *S. cerevisiae* and *C. albicans* grew in the yeast form, and on SLAD they produced filaments, while on medium containing serum *S. cerevisiae* was in the yeast form and *C. albicans* produced filaments. Since *Candida* is the asexual form of *Saccharomyces*, filament presence in serum is probably a recent adaptation allowing it to infect a vertebrate host.

Madden, Jessica. Catawba College. The Effects of Antibacterial Handsoap on Resistance in Gram Positive Skin Bacteria.

The consumer use of antibacterial products may cause the selection of resistant bacteria. Resistance would mean that products containing antibacterial agents would no longer be able to kill harmful bacteria. This research is to determine if using a liquid anti-bacterial handsoap can select for resistant bacteria. The antibacterial substance being studied is Triclosan (2,3,4'-Trichloro-2'-hydroxydiphenyl ether); a chemical commonly used in soaps and plastics. An experimental group consisting of ten Catawba College students washed their hands three times a day with the liquid antibacterial handsoap Dial, containing Triclosan and the control group, of ten students, used a liquid handsoap without Triclosan. Bacterial samples from the hands of subjects in both groups were taken over a four-week period. Gram positive cocci were analyzed for resistance to Triclosan. The MIC (minimum inhibitory concentration) for Triclosan was determined by growing the Gram positive cocci on nutrient agar plates containing different concentrations of the chemical. The MIC value, for both groups, was 6.4 µg/mL. In the control group over four-weeks there were an average of 5.00 strains of Gram positive bacteria isolated that survived on 6.4 µg/mL Triclosan. The experimental group had an average of 7.25 strains isolated that survived on 6.4 µg/mL. The experimental group demonstrated a larger number of resistant bacteria than the control group.

MORGAN, LIANE R. and Dr. TODD STECK. University of North Carolina at Charlotte – Induction of the Viable but Nonculturable Condition in *Escherichia coli*: Influence of Heavy Metal Ions.

The Viable but Nonculturable Condition (VBNC) is defined as a state in which bacteria retain their viability yet display no detectable growth on non-selective growth media. This condition has been characterized in many gram-negative bacteria and may be a mechanism by which bacteria respond to external stresses such as starvation and temperature shock. Copper (II) has recently been shown to induce VBNC in *Escherichia coli* when concentrations are below 100 µM. The purpose of this project is to determine if copper (I) can induce VBNC in *E. coli* and to explore other heavy metal ions for the same potential. Cells were shown to become VBNC in the presence of copper (I), however it appears that this decrease in culturability and retention of viability may be due to copper (I) oxidizing to copper (II).

Other heavy metal ions were tested for their potential to induce VBNC in the same bacterial strain. Aluminum (III), Zinc (II) and Iron (III) were chosen for this project based on their reported toxicity to bacterial cells. Results thus far show liquid microcosms containing copper (I), copper (II), and iron (III) have reduced culturability to non-detectable levels yet retention of viability has been noted, (although not with identical kinetics) as determined by use of a commercial viability kit.

Ossowski, Kathryn L. Wake Forest University- "The effect of larval cestode products on host fibroblasts "

Infection of humans with the eggs of the parasite *Taenia solium* can lead to larval infestation called cysticercosis. Because of its close resemblance to the human infection, a murine model of cysticercosis has been developed. In this model, the larvae of *Taenia crassiceps*, a tapeworm of canines, are used to infect mice. Larval *T. crassiceps* reproduce by budding and the larvae grow in the peritoneal cavity of infected mice. Protective immunity to the larvae appears to require host cell encapsulation and release of toxic products of the host cells onto the surface of the larvae. The focus of the research presented here is to determine if host cells are chemotactically attracted to the larvae and whether or not the larvae produce and secrete substances that affect host cell migration. A chemotaxis assay was developed to measure the migration of murine fibroblasts in the presence or absence of secreted parasite products and in the presence or absence of parasitic membrane proteins. If host cells are affected by chemoattractive substances of parasite origin, then it is predicted that migration will be affected in the presence of larval extracts. Preliminary results suggest that there are some substances present in larval extracts/secretions that affect the migration of fibroblast cells.

PHAM, DAT; T.R. STECK. University of North Carolina at Charlotte. Chemical induction of viable-but-nonculturable (VBNC) state in *Rhizobium leguminosarum*.

The viable but nonculturable response (VBNC) is exhibited in many bacteria when they are exposed to environmental stress. VBNC bacteria are still metabolically active but are

unable to give rise to colony-forming-units on a non-selective rich or minimal media. This makes detection of VBNC cells difficult since they cannot be assayed through standard microbiological methods. *Rhizobium leguminosarum* are soil dwelling bacteria responsible for nitrogen fixation in some legumes. When varying concentrations of cells were exposed to varying concentration of copper, it was observed that colonies did not form on agar growth medium even after removal of the element, yet the cells were metabolically active. Cells have remained in this condition for months. Copper, a component of contaminated soils, is thought to be toxic to *Rhizobium*. It appears that the element can actually induce the VBNC response in *R. leguminosarum*.

Ryan, Valerie T. Florida Institute of Technology—*In vitro* Formation of the Nucleoprotein Complex that Triggers Initiation of DNA Replication in *E. coli*.

Initiation of DNA synthesis is triggered by the binding of proteins to replication origins. At least three proteins interact with the *E. coli* chromosomal replication origin, *oriC*, with cell cycle specificity. DnaA, the primary initiator protein, interacts with four specific sites (R boxes) in *oriC*. Integration host factor (IHF) and Factor for inversion stimulation (FIS), are accessory proteins with specific binding sites in the left half and right half of *oriC* respectively. In cycling cells, a FIS and DnaA-bound nucleoprotein complex switches to an IHF and DnaA-bound form coincident with the triggering of new rounds of replication. DnaA binding is detected at a previously unoccupied R3 site on the IHF-bound complex. Little is known about the relationship of FIS and IHF to the binding of DnaA at its *oriC* sites, although IHF stimulates DnaA-catalyzed unwinding of supercoiled *oriC in vitro*. We observe that on purified supercoiled *oriC* templates, IHF protein enhances the binding of DnaA to sites R1, R2 and R3 as well as several non R box sites. Enhanced DnaA binding at these sites was dependent on IHF binding to its cognate sites and also required a functional R4 binding site. The redistribution of DnaA binding from strong to weak *oriC* sites by IHF suggests a mechanism whereby binding of the accessory protein reduces the amount of DnaA required to trigger initiation of DNA replication

SEXTON, JENNIFER D. Erskine College---Autism Associated with Partial Trisomy of Chromosome 2p.

Autism is the most typical and severe of the Pervasive Developmental Disorders, affecting about four out of 10,000 individuals and four times as many boys than girls. It is defined by disturbances in the development of social and communicative skills, as well as certain restricted, repetitive, or stereotyped behaviors. Though the etiology of autism has been a topic of debate since its first description by Leo Kanner in 1943, twin and family studies have shown that genetic factors play a major causal role in many cases of autism. Moreover, approximately 5-14% of autistic cases co-occur with a known genetic condition or chromosomal abnormality. I report on a patient with autism who has maternally derived unbalanced insertion of a fragment of the p arm of chromosome 2 into the q arm of chromosome 18 [46, XY,der(18)ins(18;2)(q22.2;p24.2p25.3)mat]. The findings of a microsatellite study suggest that a susceptibility gene(s) for autism may reside in the short arm of chromosome 2.

THOMAS, LESLIE N.¹, PAUL R. BAKER, and ROBERT L. WYKLE², Catawba College Department of Biology¹ and Wake Forest School of Medicine²—Regulation of PAF Formation in Human Neutrophils.

Platelet activating factor (1-O-alkyl-2-acetyl-sn-glycero-3-phosphocholine; PAF) is a potent biological mediator which provokes inflammatory responses in a variety of cell types. The metabolic pathway of stimulated PAF formation in human neutrophils (PMN) is known to be dependent on phospholipase A₂ (PLA₂) and on acetyl Co-A: lyso-PAF acetyltransferase. However, the regulation of these enzymes' activities is poorly understood. Recently, we have shown that the enzyme responsible for the final step of PAF biosynthesis, acetyltransferase, appears to be activated by a mitogen activated protein kinase, namely p38 kinase. We now have data that indicate PAF formation in PMN stimulated by A23187 (a calcium ionophore) can be blocked by a p38 inhibitor (SB203580). To complement these findings, studies using the chemotactic peptide, fMLP were carried out; 10μM fMLP increased PAF formation by 1.4 fold, relative to control. The increase could be attenuated by SB203580, but not by PD98059, which blocks the extracellular regulated MAP kinase pathway. The use of the two inhibitors together returned PAF formation to control levels. These data suggest that p38 kinase plays a crucial regulatory role in stimulated PAF synthesis, but also indicates an enzyme under control of the ERK pathway, potentially cPLA₂, also contributes to stimulus-induced PAF formation.

Velleff, Jason. Florida Institute of Technology ---The Effects of Dihydrofolate Reductase Inhibitors, both Singly and in Combinations, on *Klebsiella pneumoniae*.

The focus of this research includes the effects of dihydrofolate reductase inhibitors, both singly and in combinations on *Klebsiella pneumoniae*. The drugs tested in this experiment are Trimethoprim (TMP), Sulfamethoxazole (SMX), and Dapsone (DDS). The minimum inhibitory concentration (MIC) and the minimum bactericidal concentration (MBC) of each drug was determined before any combinations were made. Then combinations with two component drugs were tested using the same two tests (these combinations include TMP/SMX, SMX/DDS, and TMP/DDS). In the case of each individual drug test, the MIC and MBC were found to agree (TMP = [20]µg/mL, SMX = [120]µg/mL and DDS = [10]µg/mL). Similarly the tests with the drug combinations yielded MIC and MBC data that agreed in all cases. However, the combination that required the highest concentration of drugs was SMX/DDS, followed by TMP/SMX. While the combination that required the smallest concentration of drugs was TMP/DDS. These results show that the combination of TMP and DDS is effective at lower concentrations than the TMP/SMX that is used in the commonly prescribed drug named "Bactrim." Furthermore, the structure of the TMP/DDS combination is more chemically stable than that for the TMP/SMX combination found in Bactrim. These results suggest that this TMP/DDS combination is a better treatment for pneumoniae than Bactrim for two main reasons: first, TMP/DDS shows a better efficacy than Bactrim; and second, TMP/DDS should elicit fewer allergic reactions than Bactrim.

DISTRICT II PAPERS

Susceptibility of Five Non-target Freshwater Species to the Organophosphate Insecticide Diazinon

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Diazinon is an organophosphate insecticide widely used on rice, fruit trees, sugarcane, corn, tobacco, and horticultural plants. Because diazinon and other pesticides are often applied near or adjacent to bodies of water (lakes, streams, reservoirs, etc.) and because diazinon has a high affinity for entering these water systems through run-off, effects of non-target organisms may occur. Hence, determining the organisms' susceptibility to diazinon is important, and the determination of effects of diazinon on non-target organisms could be used in ecological risk assessments, either prospectively or retrospectively. *Ceriodaphnia dubia* (waterflea), *Daphnia magna* (waterflea), *Hyalella azteca* (amphipod), *Chironomus tentans* (non-biting midge), and *Pimphales promelas* (fathead minnow) were exposed to aqueous concentrations of diazinon over a 48-hr period to contrast exposure responses. As expected, *C. dubia* (300 % mortality/ug/L) was the most sensitive species tested, while *P. promelas* (0.0048% mortality/ug/L) was the least sensitive species. All of the invertebrates were over 300 times more sensitive to diazinon than was the vertebrate species, *P. promelas*. Among the two daphnid species, *C. dubia* was at least an order of magnitude more sensitive than *D. magna* (25.64% mortality/ug/L). These determinations provide baseline information concerning the relative sensitivity of a suite of freshwater non-target organisms to diazinon.

Forrester, Laura E. Columbus State University

Preferred habitats of the *Myotis lucifugus*, little brown bat, in Climax Caverns, Decatur County, Georgia.

A study of *Myotis lucifugus*, commonly known as the little brown bat, was undertaken to ascertain habitat variables associated with winter roosting of a population in the Climax Caverns of Decatur County, Georgia. The cave was visited twenty times at regular intervals between August, 1998 and January, 1999. Ambient temperature, air flow, and moisture levels were measured in the area in which the bats were roosting. The mean temperature over this period was 17°C and mean wind speed was 0.23 km/h. Moisture, ranked on a scale with values ranging from 1 to 5, had a mean value of 3. This population relocated within the cave between December, 1998 and January, 1999. Data indicates that the relocation might have been prompted by increases in the level of moisture and air flow.

HAIR, SEAN R. and JOSHUA WHITE. Birmingham-Southern College—Analysis of Material Culture Remains from Birmingham-Southern College Residential Areas.

Archaeology students analyzed 110 bags of trash collected over an eight-week period from the residential areas of the college. SPSS was used to identify trends and relationships between gender, student age, and trash composition. First year males and coeds in student apartments

discarded per person the greatest amount of trash, perhaps reflecting lack of knowledge of recycling among first year students and the availability of kitchens in the apartments. Overall first year students discarded more trash than did upper class students. Soda containers were most abundant in first year male dormitories and least abundant in the apartments. Diet soda remains were most abundant in the trash from first year female dorms as was milk containers, hygiene products, and nutritional food remains. These health-oriented items were least abundant in the first year male dorms. Alcohol containers were most abundant in the apartments and in upper class male dorms. These data suggest that females may be more health-conscious than are their male counterparts. Recyclable materials (glass, plastic, and aluminum) were least common in areas where recycling containers are readily available, implying availability of recycling containers is directly associated with incidence of recycling.

LEGGETT, CAROLINE T. University of Tennessee, Knoxville and Maryville College—The transformation of *Arabidopsis thaliana* with apyrase and hygromycin resistance genes using *Agrobacterium tumefaciens*

Agrobacterium tumefaciens is recognized as the soil-borne bacterium responsible for crown gall disease in plants. The bacterium has the ability to infect a plant at a wound site and transfer a piece of the bacterial DNA to a cell near the wound. Two sets of wild type *Arabidopsis thaliana* (PS46A3 and PS46A4) were transformed by the infection of *A. tumefaciens* through vacuum infiltration. The bacterial construct used consisted of PS46A plasmid and the genes for apyrase and hygromycin resistance. The transgenic plants were selected using kanamycin and were grown for two generations. The phenotypes of the T2 generation plants were analyzed. PS46A4 T2 generation plants exhibited five phenotypes: dwarf, red rosette/dwarf, small plant/small rosette, small rosette, and normal. PS46A3 T2 generation plants exhibited seven phenotypes: dwarf, red rosette/dwarf, small plant/small rosette, small plant/small red rosette, small rosette, small rosette/ bush, and normal.

OWENS, D.K.¹, HALE, T.L.T.², WILSON, L.J.², MCINTOSH, C.A.¹. Dept. Biol. Sci.¹, Dept. Chem.², East Tennessee State University—Development of a Sensitive Quantitative Assay for Flavanone 3-Hydroxylase

Higher plants are characterized by the production of natural products. Natural products have diverse roles in the plant life cycle and functions that can be utilized by man. A major grouping of natural products are the phenolics including the flavonoids. Biosynthesis of the primary C-15 system of flavonoids has been well characterized. Our goal is to elucidate control of the branchpoint in flavonoid metabolism. One of the key enzymes in the branchpoint is flavanone-3-hydroxylase (F₃H). Condensation of 3 malonyl CoAs onto 4-coumaroyl CoA is catalyzed by chalcone synthase, producing a chalcone. Then, chalcone isomerase catalyzes the production of a flavanone by cyclization. At this point, the flavanone can undergo functional group ring substitution or can undergo further derivation. In the latter case, isoflavones, flavanones, or dihydroflavanols can be produced. Flavanone-3-hydroxylase catalyzes the production of dihydroflavanols. Current methods for the assay of F₃H are either very expensive (radiolabeling) or only semi-quantitative (TLC). Therefore, detailed information of F₃H activity is lacking. We are developing a quantitative assay based on capillary electrophoresis technology. Capillary electrophoresis is a relatively new technique that is an excellent detection system because it can identify the presence of compounds in nanomolar quantities. The resulting data will be used to elucidate regulation of the flavanone branch point.

BEHAVIORAL AND NUMERIC RESPONSE TO RESOURCE MANIPULATION IN ARTHROPOD COMMUNITIES

Mary Katherine Razer, Department of Biology, Hendrix College, 1600 Washington Avenue, Conway, AR 72032

We investigated the bottom-up effect of resource enhancement on an arthropod assemblage in an early successional field. Increased nitrogen, through fertilizer addition, enhanced herbivorous and carnivorous arthropod abundance. The taxa that responded the most to nutrient enhancement were Homoptera and Orthoptera. While some increased abundance may have been caused by increased survival within plots, some increases were probably due to behavioral changes. We found that cursorial spiders emigrated at a lower rate from fertilized plots compared to unfertilized plots. This reduced emigration in the nutrient enriched plots probably increased predation on herbivorous taxa, providing a possible explanation why many taxa showed no significant numerical response. This underscores the value of monitoring behavior when investigating the effects of resource manipulation, as numerical changes can result from changes in survival, reproductive output, or emigration and immigration.

Roever, Theodor W. Columbus State University - A Comparison of Fish Populations In Channelized and Unchannelized Streams

A survey was conducted of the ichthyofaunal communities of two lotic, second-order streams, one of which appears to have been channelized, on the Eufaula National Wildlife Refuge in Barbour County, Alabama. Samples were taken to determine if there might be a quantifiable difference between the populations of the two streams. Three samples were taken at each of two sites in each stream using a backpack electrofisher and dipnets. Each sample was taken from a reach of stream approximately ten times its width. A total of 1343 individuals of 26 species were collected including, but not limited to, eight centrarchids and seven cyprinids. Cluster analysis revealed that within stream variation was as pronounced as between stream variation, suggesting that channelization had no appreciable effect on the fish community. On the other hand, ordination analysis revealed wide variation in the upper and lower reaches of the channelized stream compared to the control stream. The fact that the ichthyofaunas of the two streams were essentially the same suggests that the channelized stream had largely recovered its ability to provide a diversity of habitats even though evidence of channelization can still be detected.

WHITE, JOSHUA and SEAN R. HAIR. Birmingham-Southern College—Analysis of Survey Completed by Birmingham-Southern College Residents.

Surveys assessing student perceptions of their trash disposal habits, views on recycling, and lifestyle were prepared and distributed to dormitory residents by students in an archaeology class. 33% of surveyed students responded and results were analyzed using SPSS. Trends and relationships between survey data and gender and class standing were identified. Survey results were also compared to data obtained from the analysis of trash recovered from the same areas. Two-thirds of the responding students said they recycle on a regular basis, while 10% claimed to never recycle. First year male students claimed to recycle the least (39%) and recyclable containers particularly soda cans were most abundant in the trash remains from these residences. Senior males claimed to recycle the most (73%) but no support for that could be found in the trash remains from those residences. Senior males reported the highest weekly alcohol consumption and alcoholic containers were most abundant in the trash from student apartments and fraternities, both areas of which are heavily populated by seniors.

WIMBROW, WENDY E. Maryville College and the University of Tennessee at Knoxville. The Isolation of Two-Component Regulator Gene Segments From *Bradyrhizobium japonicum*.

Leguminous plants are able to form a symbiotic relationship with bacteria such as *Rhizobium* and *Bradyrhizobium*. This symbiosis results in the formation of nodules in the plant root, which are the sight of nitrogen fixation. The ability of leguminous plants to form this symbiosis and thus to fix atmospheric nitrogen is of great economic importance. One way to study this symbiosis focuses on specific gene segments in various bacterial species which have been isolated and categorized as belonging to the family of sigma 54 dependent activators. Among other characteristics, these bacterial gene segments are involved in accessory metabolic functions, including nitrogen fixation. Using the soil bacteria *Bradyrhizobium japonicum*, specific primers and the polymerase chain reaction method were used to isolate specific gene segments. These gene segments, referred to as two-component regulation gene segments, were successfully replicated and subsequently isolated. Four unique segments were isolated from the *B. japonicum* genome. Further studies showed that two of the four segments isolated were homologous to other sigma 54 dependent activators. Future studies may include attempts to determine the function(s) of these gene segments.

DISTRICT I POSTERS

Ward Jr, James T. Winthrop University---The Histochemistry and Possible Antimicrobial Aspect of the Planarian *Dugesia dorotocephala*.

The definition of what constitutes a true rhabdite cell in the triclade planarian is unclear. It is well known that most triclade planarians release a secretion that is unpleasant to many "would be" predators when aggravated. However, it is not known whether these rhabdoid secretions

play an antimicrobial role. Experiments that consisted of allowing the planarian *Dugesia dorotocephala* to travel in a petri dish of minimal media and pond water were conducted to determine the role of rhabdite secretions as an antimicrobial agent.

DUNLAP, AMANDA L. Winthrop University — Characterizing the feeding behavior of *Nezara viridula* (L.), a South Carolina crop pest.

There has been extensive research done on the southern green stink bug, *Nezara viridula* (L.), as a pest on tomato, cowpea, soybean, cotton, citrus, beans, pecan and other crops, but very little is known about the insect's feeding behaviors. True bugs, with their piercing mouthparts, pose a challenge to research on feeding behavior; actual feeding cannot be observed because it takes place within the plant tissues. The electronic feeding monitor and an attached strip chart records when the insect probes, salivates and ingests by the differing voltage patterns, or "waveforms." The purpose of this study was to adapt the electronic feeding monitor (developed for very small insects) for use on the much larger southern green stink bug. Using this technique, in addition to fruit staining of salivary deposits with acid fuchsin, will allow for comparisons of feeding behaviors on different crop plants.

GANCARZ, BRANDI L.* and MYA E. BREITBART. Florida Institute of Technology - An Analysis of Plasmids in Invertebrate Associated Microbes from Antarctic and Temperate Marine Ecosystems

Microbes associated with marine invertebrates collected from Fat Deer Key, Florida and McMurdo Sound, Antarctica were cultured and purified. An alkaline lysis protocol was used to screen 94 temperate and 239 Antarctic microorganisms for the presence of extra-chromosomal elements. One or more plasmids were detected in 29.3% of the Antarctic isolates and in 23.4% of the temperate isolates. There was a higher frequency of large plasmids (> 16.2 kb) detected in the temperate microbes (53.3%) than in the Antarctic microbes (15.0%). Our results support prior findings that plasmids are ubiquitous in microbial assemblages of temperate and Antarctic marine ecosystems. Initial efforts to de-replicate microbes using antibiotic resistance patterns indicate that temperate and Antarctic isolates have differing susceptibilities to gyrase inhibitors. Ongoing research in our laboratory involves sequencing of bacterial plasmids and evaluation of their superhelical density.

Johnson, B. S., Dimaculangan, D. McTadden, A., Bhardwaj, S., Smith, J. III. Winthrop University. Identification of a LIM-Domain homologue, LMO-1, in regenerating flatworms, *Dugesia dorotocephala*.

A cDNA clone corresponding to the LIM-domain protein LMO-1, also known as RBTN-1/Ttg, was amplified from 24-hour regenerating flatworm RNA using RT-PCR with degenerate primers directed towards the zinc fingers of nuclear receptors. LIM-domain proteins contain cysteine-rich zinc finger motifs that mediate protein-protein interactions. LMO's constitute a subfamily of LIM-only proteins that consist of two LIM domains and act as transcriptional cofactors that regulate the terminal differentiation and growth of vertebrate cells. Northern analysis and *in situ* hybridization is currently underway to determine the pattern of gene expression in *D. dorotocephala*, and ultimately, the protein's role in the regenerative processes of invertebrates.

Donald J. Reinhardt¹, Susan Huff¹, Tanja Popovic², Georgia State University¹, Atlanta, Ga. and Centers for Disease Control², Atlanta, Ga.

Three different methods for the detection of diphtheria toxin, developed in our laboratory, were compared and contrasted with the standard Elek procedure. The techniques used were: a. m-CIE, (microcounterimmunoelectrophoresis) b. m-LSSA, (microloop stab-surface-antibody analysis) c. m-AIW (micro-antibody-in-well). Each procedure could detect strong, toxigenic strains (496, 510, 880) and most

intermediate toxigenic strains (G4169, G4177, G4179). Only the m-AIW and standard Elek procedure detected the weakly toxigenic 881 test strain. An evaluation of blinded toxigenic and atoxigenic unknowns showed a 99% agreement of m-AIW and a >90% agreement of m-LSSA and m-CIE with standard Elek tests. The m-AIW detected toxigenic strains as early as 4-5 h to 8-12 h after inoculation of colonies from isolation plates into Elek agar test. This is the most rapid immuno-precipitin test developed to date. Similar early toxin detection from growing colonies of *C. diphtheriae* were obtained with the m-LSSA technique. Precipitin bands were not as distinct as m-AIW and occasional fading occurred during incubation. Weak strains were not detected by m-LSSA. M-CIE results were reproducible and consistent when all aspects of antigen placement, media, distance, voltage and milliamperage were standardized and controlled. This is the first, clearly-documented CIE detection of diphtheria toxin in agar cultures of *C. diphtheriae*. No toxin was demonstrable by CIE in Elek broth.

LEGRAND, KARINE F. Florida Institute of Technology-- Effect of Various Dihydrofolate Reductase Inhibitors, Used Singly and in Combination, on In Vitro Growth of E. Coli.

The action of dapsone, trimethoprim, pyrimethamine, brodimoprim and epiroprim, singly as well as in combination was determined on the in vitro growth of *E. coli*. Turbidity method was used to determine the MICs and the MBCs. Plating method was used to determine MBCs. Dapsone did not inhibit the growth of *E. coli* at any concentration. It was considered that trimethoprim at 100 µg/ml was bacterostatic. Pyrimethamine at 90 µg/ml and brodimoprim at 100 µg/ml were bacterostatic. Epiroprim at 80 µg/ml was bactericidal. The combinations of dapsone with trimethoprim, pyrimethamine, epiroprim or brodimoprim did not inhibit the growth of *E. coli*. The combinations of brodimoprim (70 µg/ml) with pyrimethamine (70 µg/ml), of trimethoprim (5 µg/ml) with pyrimethamine (100 µg/ml) were bacterostatic. The combinations of epiroprim (50 µg/ml) with pyrimethamine (70 µg/ml), of epiroprim (30 µg/ml) with brodimoprim (70 µg/ml), of epiroprim (40 µg/ml) with trimethoprim (5 µg/ml), and of brodimoprim (70 µg/ml) with trimethoprim (1 µg/ml) were bactericidal.

PARK, MARGARET A. Erskine College--Characterizing KH RNA-Binding Domains: Their Structure and Function in Two Homologous Proteins, Vertebrate Vigilin, and Scp160p

KH-domains are RNA-binding domains found in many proteins. Two projects characterize them more fully. Firstly, the GFP and LacZ reporter genes were inserted into the Gem3ZF+ plasmid. The GFP and LacZ genes are called reporter genes because the protein products from GFP fluoresce and the products of the LacZ gene can also be easily detected. Vigilin's normal expression in human cells is to associate with polysomes, found in the cytoplasm. However, Vigilin did not associate with polysomes as expected when the protein was expressed in yeast. Therefore, it was thought that a segment of Vigilin-recognizable RNA was needed in the cells before Vigilin would associate with polysomes. After the reporter genes' insertion is successfully completed, a 3' UTR (untranslated region) of the protein Vitellogenin, a region which has been proven to be Vigilin-binding, will be inserted into the plasmid. Vigilin is an important human protein and contains 15 KH domains. Secondly, the Scp160p yeast homologue protein to the vertebrate Vigilins was purified. Mutations and/or deletions in the gene encoding Scp160p, while not lethal, do cause decreased cell viability, increased DNA content, uneven distribution of chromosomes and enlarged nuclei. This protein is thought to have a role in the exact distribution of DNA during mitosis. This protein is 160kD and has 14 KH-domains. The protein is located to the cytosolic side of the nuclear envelope and endoplasmic reticulum membrane networks.

D Scott, Yun, D, and M Stacey. E.V.M.S./C.H.K.D. Center for Pediatric Research Norfolk VA. Identification of hBUB1 gene expression and correlation with aneuploidy in leukemic cells.

Introduction and Objective. Mitotic checkpoint genes regulate transition from metaphase to anaphase in actively dividing cells. The hBUB1 gene product produces a 1.2 Kbp fragment from a conserved domain following RT-PCR. The gene product is a dominant negative protein. This project correlated mutant hBUB1 gene expression with aneuploidy in patients with various forms of leukemia.

Methods: hBUB1 gene expression and the identification of mutant alleles were determined by RT-PCR and DNA sequencing. Aneuploidy was determined by multi-color fluorescence in-situ hybridization. Chi-square analysis was performed.

Results: RT-PCR identified 1.2 and 1.6 Kbp alleles for HL-60, a positive leukemic cell line control. ALL, ANLL, and MDS patients all had 1.2 and 1.3 Kbp alleles. Non dividing white blood cells showed no hBUB1 gene expression.

FISH Analysis				
CHROMOSOME	ALL	MDS	ANLL	CONTROL
1	28*	50*		18
7	61*	112*		14
8	50*			18
11	43*		50*	8
17	37*	7		8

Controls = 1000 per chromosome
Patients = 200 - 500 per chromosome
* p<0.05

Conclusion: RT-PCR showed hBUB1 gene expression for all patients. Different size bands indicate possible existence of mutant alleles.

SEXTON, JENNIFER D. Erskine College—Characterization of cytokine mRNA levels during the induction phase of autoimmune orchitis in BALB/cByJ and BALB/cJ mice.

BALB/cJ and BALB/cByJ mice, though genetically very similar, display differential susceptibility to experimental allergic orchitis (EAO) and experimental allergic encephalomyelitis (EAE). BALB/cByJ mice are susceptible to both diseases, whereas BALB/cJ mice are resistant. Recent studies suggest that a mutation in a common immunoregulatory locus in the pathways leading to these two autoantigenically distinct CD4+ T cell-mediated, organ-specific autoimmune diseases underlies resistance in BALB/cJ mice.

In this study, mRNA levels for a variety of cytokines were examined at various time points throughout the induction phase of EAO. Quantification of splenic mRNA was performed using RNase protection assays. Basal levels of TNF- α and INF- γ mRNA were significantly greater in BALB/cJ mice as compared to BALB/cByJ. In contrast, by day 9 post-injection, BALB/cByJ mice expressed greater levels of TNF- α , TNF- β , INF- γ , TGF- β 1, TGF- β 3, and MIF mRNA. These results suggest that the mutation in BALB/cJ mice responsible for resistance to EAO and EAE may be in a regulatory element or gene controlling the transcription of cytokine mRNA, particularly TNF- α and INF- γ . Furthermore, the results suggest that the increased basal level of expression of these two cytokines impairs the ability of BALB/cJ mice to generate the Th1 effector cells required for eliciting disease.

DISTRICT II POSTERS

BARTLETT, LOUIS SCOTT. Northern Kentucky University — Escherchia coli survival in soil

E. coli is a commonly used indicator of fecal contamination and has been reported to persist in water for up to twenty-eight days in temperate areas of the world. There have been few studies concerning the longevity of *E. coli* in soil but recent work conducted in tropical regions suggest that *E. coli* may actually grow and occupy soils rich in organic matter. Under laboratory conditions, I report that *E. coli* can survive and even increase in numbers when cultured in soil that was sterilized before inoculation. Viable *E. coli* cells were harvested from soil samples held at room temperature after forty-two days of incubation. *E. coli* has the ability to survive and reproduce in soil in the absence of competitors.

FRANKLIN, VICTORIA S. East Tennessee State University — Environmental Influence on Crayfish Carapace Color, Orconectes.

Crayfish are freshwater, benthic invertebrates whose main defense against predation is camouflage. This species of *Orconectes* is usually a reddish-brown color when found among the rocks of the North Fork of the Holston River. This study shows that juvenile *Orconectes* are able to mimic artificial substrate coloration. Thirty crayfish, each less than 2.5 cm in length, were placed in containers with one of five different colors of aquarium rock; red, blue, yellow, green and white. Those specimens placed in the primary color substrates of red, blue and yellow exhibited the most distinctive color adaptations. These adaptations were documented by photographs at the end of one month.

HORNBuckle, LAURI A. and MARK E. CHRISTENSEN. Georgetown College -- PCR Analysis of the Archaeon *Sulfolobus acidocaldarius* for the Fibrillarin-Encoding Gene

Fibrillarin is a 34 kD nucleolar protein essential to rRNA processing in eucaryotes. While the gene encoding fibrillarin is detected consistently throughout *Eucarya*, none of the sequenced bacterial genomes contain a homologous gene. Such a sequence has been found, however, in *Archaea* (formerly *Archaeobacteria*). The kingdom *Crenarchaeota*, not previously studied for the fibrillarin gene, contains the thermoacidophilic archaeons which include the aerobe *Sulfolobus acidocaldarius*. After PCR with positive control primers had confirmed its identity, *S. acidocaldarius* DNA was analyzed for the fibrillarin-encoding gene. PCR analysis, conducted with several combinations of primers specific to conserved sequences of the fibrillarin gene, did not produce a definitive signal. The results suggest that the *S. acidocaldarius* genome does not contain the sequences of the primers,

although a fibrillarin-encoding gene of differing sequence may be present. Future investigations include the Western blot analysis of *S. acidocaldarius* for fibrillarin. The detection of the protein and its gene in this organism would suggest similarity in the rRNA processing mechanisms of *Archaea* and *Eucarya*, perhaps promising a model for studying our own domain.

ANNE M. TIMMERMAN, University of Tennessee at Martin. Virulence factors produced by vancomycin sensitive and resistant strains of *Enterococcus faecalis* isolated from different anatomical sites.

E. faecalis, responsible for a great number of nosocomial infections, has been reported to produce a hemolysin and a protease. In addition, an increasing resistance to the antibiotic vancomycin is serious problem among members of this species. The aims of this study were: 1) to determine the presence of a correlation between production of these factors and induction of infection at a particular site and 2) to examine patterns between the factors produced by vancomycin sensitive and resistant strains. Strain origins and resistance were known prior to the collection of data. Milk and gelatin agar plates were inoculated with each to determine protease production and horse blood agar was inoculated to examine hemolysis patterns. When vancomycin resistant strains (n=21) were compared to vancomycin sensitive strains (n=26), no significant differences in β -hemolytic activity or protease production was observed. In addition, no significant correlation was found between the site of infection (wound, urine, or blood) and production of these toxins. These results argue against the suggestion that hemolytic or proteolytic strains exhibit an increased propensity to cause infections at certain anatomical sites.

THE EFFECT OF INF- α ON THE GROWTH OF HUMAN LIVER CARCINOMA CELLS (HLCC) AND THEIR EMISSION OF FIREFLY AND LUCIFERASE GENES (Jones, Marcus, Samantha Croft, and William R. Fleischmann at the University of Texas Medical Branch)

The purpose of our experiment was to determine if interferon had a differential effect on the expression initiated by the 7M-guanosine cap used by cells and the internal ribosomal landing site (IRES) used by some viruses. To test interferon's effect, we conducted a dual-luciferase assay with one luciferase gene initiated by 7M-guanosine and another by IRES. Also, a growth kinetics assay was conducted in order to determine if interferon acted as a growth inhibitor to the cells. Human liver carcinoma cells (HLCC), bearing the dual-luciferase genes, were treated with Interferon- α A/D and Interferon- α (IFN- α) by means of a plaque assay, to establish whether recombinant interferon or interferon from human lymphocytes was more suitable to use. The data obtained from this assay established that either of the IFN was equally effective. After establishing an IFN titer, a growth kinetics assay was conducted on the HLCC. The cells were then cloned and treated with IFN- α at levels of 1.87×10^3 IRU, 1.12×10^5 IRU, and 5.6×10^6 IRU. A dual-luciferase assay was also conducted to detect whether IFN had a differential effect on the levels of renilla (7M-guanosine cap controlled) and firefly (IRES controlled) luciferase expressed from the cell's plasmid. To insure the accuracy of both assays, the same levels of IFN were used to conduct the luciferase assay. Taken together, our results suggest that IFN had a suppressive effect on the growth of the HLCC. However, it did not appear to have a differential effect on the two translation initiators.

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In This Issue

A MESSAGE FROM THE PRESIDENT	193
EVENTS OF THE 1999 ANNUAL MEETING	194
1999 RESEARCH AWARD RECIPIENTS	197
TREASURER'S REPORT	198
ASB OFFICERS, COMMITTEES AND REPRESENTATIVES AND <i>ASB BULLETIN</i> STAFF, 1999 - 2000	201
2000 MEETING OF THE ASSOCIATION	205
CALL FOR PAPERS	205
GUIDELINES FOR POSTER SESSION AND ASB POSTER AWARD ..	210
NOMINATION FOR ASB OFFICERS	211
"TRAVEL" SUPPORT AWARDS	212
ASB MERITORIOUS TEACHING AWARD	213
NOMINATION FORM FOR THE ASB MERITORIOUS TEACHING AWARD, 2000	214
RESEARCH AWARDS	215
REVIEWS	218
NEWS OF BIOLOGY IN THE SOUTHEAST	230
BETA BETA BETA ABSTRACTS	234

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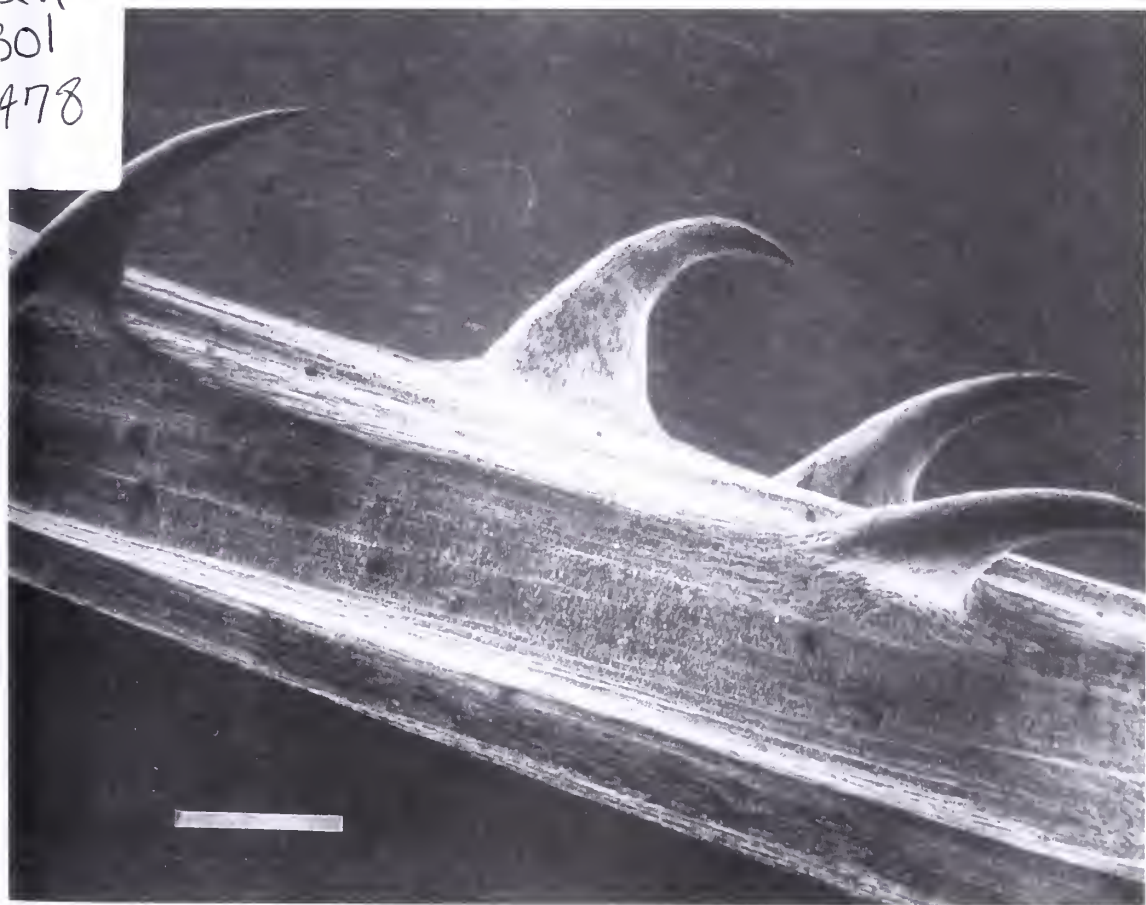
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Coastal Ecology Symposium

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Polygonum perfoliatum (Polygonaceae) stem with retorse prickles (Bar = 100 μ m)

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PURPOSE

The purpose of this association shall be to promote the advancement of biology as a science by encouraging research, the imparting of knowledge, the application of knowledge to the solution of biological problems, and the preservation of biological resources. The ASB has representation in Section G Committee of the AAAS. Varying types of membership are available to individuals and institutions. Members receive the *ASB Bulletin*.

TIME AND PLACE OF FUTURE MEETINGS

2000	April	5-8	University of Tennessee at Chattanooga, Chattanooga, TN
2001	April	4-7	Tulane and Loyola Universities, New Orleans, LA
2002			

COASTAL ECOLOGY SYMPOSIUM PROCEEDINGS

60th Annual Meeting of ASB in Wilmington, NC

The coastal zone is a region that has, in recent years, been subject to increasing human population and developmental pressures. Consequently, many ecosystems and species assemblages associated with the coast have undergone dramatic changes or have been lost. During the 1999 Annual Meeting of the ASB hosted by the University of North Carolina at Wilmington, a symposium on "Coastal Ecology" was held on Friday April 16. The symposium was convened by Drs. Michael J. Durako and Robert Y. George, both faculty members at UNCW. The purpose of the symposium was to present review papers on aspects of coastal ecology of the southeastern United States with an emphasis on recent issues dealing with biodiversity, biogeography and conservation. The following eight papers were presented:

Plant communities at the land/sea interface: Why do we need to protect them?

William Kruczynski, U. S. Environmental Protection Agency

Changes in seagrass distribution and diversity: Is this a good thing?

Michael Durako, University of North Carolina at Wilmington

Coastal phytoplankton blooms: What are they telling us?

Gabriel Vargo, University of South Florida

Coral reef conservation: What are the global and regional issues?

John Ogden, Florida Institute of Oceanography

Biological impact of the Gulf Stream on coastal marine ecosystems: Are there seasonal and climatological signatures?

Robert Y. George and David Lindquist, University of North Carolina at Wilmington

Coastal fish distribution and diversity in the S.E. U.S.: How is it changing?

Stuart Poss, University of Southern Mississippi

Sea turtle distribution and breeding along the southeastern coast: Can we maintain our populations?

David Webster, University of North Carolina at Wilmington

Potentials for aquaculture along the coast: A North Carolina example.

Harry Daniels and Ron Hodson, North Carolina Sea Grant

This special volume of the ASB Bulletin includes five review papers based on presentations at the symposium. The symposium organizers wish to thank Dr. Ron Hodson and North Carolina Sea Grant College for providing funds to bring the symposium participants together to present their timely reviews during the ASB Annual Meeting.

Michael J. Durako and Robert Y. George

Department of Biological Sciences and the Center for Marine Science Research

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THE IMPORTANCE OF COASTAL WETLANDS: WHY DO WE NEED TO PROTECT THEM?

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ABSTRACT

Coastal wetlands are vegetated communities that occur in transitional zones between terrestrial and aquatic environments. They are dominated by hydrophytic vegetation, plants adapted for life in saturated soil conditions. Coastal wetlands are generally vegetated by few plant species present in great abundance. Species dominance is controlled by a combination of salinity, temperature range, tidal amplitude, and elevation. Salt marshes along the south Atlantic and Gulf coasts are usually dominated by *Spartina alterniflora* at higher salinities and low elevations and by *Juncus roemerianus* at lower salinities and higher elevations. Mangrove wetlands generally replace salt marshes in tropical and subtropical areas.

Coastal wetlands perform many valuable ecological functions including habitat, food chain productivity, water quality enhancement, and erosion protection. As many as 95% of commercial fish and 85% of sport fishes landed spent a portion of their life in coastal wetlands and adjacent estuaries. Estimated values of coastal wetlands range from about \$100 per hectare per year for single functions to over \$14,000 per hectare per year for all ecosystem services.

Serious deterioration and losses of coastal wetlands are evident in many locations and most impacts are directly linked to increased human activities. Detrimental human impacts include draining, impounding, dredging, filling, and discharges of sediments and other wastes from point and non point sources.

Of the original 87 to 89 million ha of wetlands present in the conterminous United States during Colonial times, approximately 42 million ha remain (53% loss). Ten states have lost more than 70% of their original wetland acreage. Freshwater wetlands experienced 98% of the losses. Approximately 2.2 million ha of estuarine wetlands remain, 51% of which occur along the Gulf of Mexico.

Population increases are greatest in coastal regions which has resulted in increased pressure for development in all coastal habitats. Subsidence due to oil and gas extraction and depriving wetlands from required sediment subsidies have led to alarming wetland losses of approximately 65-91 km² per year in coastal Louisiana. In addition, storm surges and rising sea level can accelerate loss of wetlands.

There has been a gradual recognition of the value of wetlands due in part to an increased understanding of their role in ecological processes and their tangible value to society. Historically, federal and state regulations have proven ineffectual at eliminating losses of coastal wetlands. "No-loss" policies and advances in creation and restoration technologies offer promise in maintaining and restoring the ecological integrity of coastal habitats, but increased compliance monitoring is required to assure success. Preservation through purchase is the only assured method to guarantee the continued existence of coastal wetlands for future generations.

INTRODUCTION

Over half of our Nation's wetlands that existed in Colonial times have been lost. Because the services that wetlands and other natural systems provide to society are not fully captured in commercial markets, their functions and values have historically been given too little weight in policy decisions. The neglect of the value of natural systems to society and their continued destruction could ultimately compromise the sustainability of humans in the biosphere (Costanza *et al.*, 1997). Wise stewardship of our remaining natural resources can only be achieved through educating world leaders and the public of their importance to the economy and to global biodiversity. This paper reviews the ecology of coastal wetlands in the United States, with an emphasis on wetlands of Florida and Gulf coast states, and summarizes the many functions and values that they provide to society.

The U.S. Fish and Wildlife Service has prepared community and estuarine profiles that provide information on the formation, species composition, productivity, ecology, and functions and values of many community types, including coastal wetlands. Students interested in details of particular community types or locations are encouraged to utilize these valuable resource materials. A list of coastal community and estuarine profiles for the southeastern United States is given in Table 1.

Functions and Values of Coastal Wetlands

Coastal wetlands perform many functions that have value to society. Wetland functions and values are summarized by Greeson *et al.* (1979), Stuber (1983), and Tiner (1984). Tiner (1984) divides wetland values into three basic categories: habitat, environmental quality, and socioeconomic values (Table 2).

The value of coastal wetlands depends upon the perspective of the beholder. For example, some view wetlands as potential sites for residential or industrial development, some as havens for fish and wildlife, and others as prospecting grounds for oil and gas production. Many attempts have been made to place a monetary value on the tangible services provided by coastal wetlands (e.g., fisheries productivity). However, these habitats provide many intangible goods and services to society, such as aesthetic values, teaching tools, and nutrient cycling that are difficult to quantify and value. Methods used to assess visual-cultural values of wetlands are discussed by Smardon (1983).

Foster (1978) observed that the environmental benefits of wetland areas are largely in the public domain, while alternative uses for wetlands are primarily for private benefit. That fact has led to widespread destruction of wetlands. While society has exerted some governmental control to maintain the public benefits of wetland resources, many difficulties are encountered in calculating the social value of wetland benefits due to the nonmarket, intangible nature of many benefits. Decisions affecting public benefit are made daily by private and governmental bodies. These decisions result in giving up some benefits to secure others. The private decision maker, in general, has little difficulty making the decisions, as intangible wetland benefits are perceived to have little value, while development may be of considerable value. On the other hand, the public decision maker must weigh

Table 1. Coastal Community and Estuarine Profiles for the Southeastern United States prepared by the U.S. Fish and Wildlife Service.

SUBJECT	AUTHOR
The ecology of open-bay bottoms of Texas	Armstrong, 1987
The ecology of intertidal oyster reefs of the south Atlantic coast	Bahr and Lanier, 1981
Ecology of maritime forests of the southern Atlantic coast	Bellis, 1995
The ecology of Barataria Basin, Louisiana	Conner and Day, 1987
The ecology of Albemarle Sound, North Carolina	Copeland and Hodson, 1983
The ecology of the Pamlico River, North Carolina	Copeland <i>et al.</i> , 1984
The ecology of petroleum platforms in the northwestern Gulf of Mexico	Galloway and Lewbel, 1982
The ecology of delta marshes of coastal Louisiana	Gosselink, 1984
The ecology of the south Florida coral reefs	Jaap, 1984
The ecology of Atlantic white cedar wetlands	Laderman, 1989
The ecology of Tampa Bay	Lewis and Estevez, 1988
The ecology of the Apalachicola Bay system	Livingston, 1984
The ecology of the mangroves of south Florida	W.E. Odum <i>et al.</i> , 1982
The ecology of tidal freshwater marshes of the United States east coast	W.E. Odum <i>et al.</i> , 1984
The ecology of intertidal flats of North Carolina	Peterson and Peterson, 1979
The ecology of irregularly flooded salt marshes of the northeastern Gulf of Mexico	Stout, 1984
The ecology of eelgrass meadows of the Atlantic coast	Thayer <i>et al.</i> , 1984
The ecology of bottomland hardwood swamps of the Atlantic coast	Wharton <i>et al.</i> , 1982
Tidal salt marshes of the southeast Atlantic coast	Wiegert and Freeman, 1990
The ecology of the seagrasses of south Florida	Zieman, 1982
The ecology of the seagrass meadows of the west coast of Florida	Zieman and Zieman, 1989

Table 2. Values of wetlands (from Tiner, 1984).

FISH AND WILDLIFE VALUES

- Fish and Shellfish Habitat
- Waterfowl and Other Bird Habitat
- Furbearer and Other Wildlife Habitat

ENVIRONMENTAL QUALITY VALUES

- Water Quality Maintenance
 - Pollution Filter
 - Sediment Removal
 - Oxygen Production
 - Nutrient Recycling
 - Chemical and Nutrient Absorption
- Aquatic Productivity
- Microclimate Regulator
- World Climate Regulator

SOCIO-ECONOMIC VALUES

- Flood Control
- Wave Damage Protection
- Erosion Control
- Groundwater Recharge and Water Supply
- Timber and Other Natural Products
- Energy Source
- Livestock Grazing
- Fishing and Shellfishing
- Hunting and Trapping
- Recreation
- Aesthetics
- Education and Scientific Research

the social values of wetland benefits against their loss. Foster (1978) concludes that the public largely condones draining, filling, or otherwise destroying wetlands because their tangible and intangible values have not been fully quantified or appreciated.

Coastal wetlands are very productive ecosystems. For example, the productivity of a tidal *Spartina* marsh can be about the same as a cultivated rice field (Table 3) (E.P. Odum, 1971). In general, net above ground primary productivity of tidal marshes varies from 200 to 3000 g dry weight/m²/year. Net above ground productivity varies by marsh zone and may be directly correlated with tidal amplitude (Kruczynski *et al.*, 1978). Below-ground production of roots and rhizomes tends to be higher than above-ground production, particularly in high marsh zones for *S. alterniflora* (Gallagher, 1975; Valiela *et al.*, 1976), *S. patens* (Valiela *et al.*, 1976), and *J. roemerianus* (Kruczynski *et al.*, 1978).

Very little of the primary productivity of coastal wetlands is utilized as an energy source within the wetland. In general, approximately 10% of net above ground

Table 3. Net Primary Production of Terrestrial and Marine Ecosystems (from E.P. Odum, 1971).

SYSTEM	NET PRODUCTIVITY (g/m ² /yr)
Theoretical Potential	
average radiation (200-400 g cal/cm ² /day)	2920-6935
maximum radiation (750 g cal/cm ² /day)	9855
Mass Algal Culture	
mean	4526
maximum	10,220
Terrestrial Systems (maximum values-growing season)	
sugar cane	6716
rice	3322
pine forest	2190
wheat	1679
tall prairie	1095
short prairie	182
desert	73
Marine Systems (maximum values-single days)	
seagrass flat	4124
coral reef	3504
salt marsh	3285
eutrophic estuary	2920
Grand Banks (April)	2372
Continental Shelf	1350 (146) ^a
Sargasso Sea	1022 (174) ^a

a = Annual Mean

primary production is consumed directly by herbivores and 90% becomes plant detritus (Wiegert and Evans, 1967; de la Cruz, 1973; Montague and Wiegert, 1990). The predominant herbivores of marshes are insects. The insect community of salt marshes of northwest Florida was described by McCoy and Rey (1981, 1987), Rey and McCoy (1982, 1983, 1986), and Hubbard (1997). The excess organic matter produced is either accumulated in place or exported to adjacent estuaries (E.P. Odum and de la Cruz, 1967; W.E. Odum and Heald, 1972; Wiegert and Freeman, 1990). The role of detritus produced in coastal habitats is reviewed by W.E. Odum, Zieman, and Heald (1973), Nixon (1980), and Durako *et al.* (1985). Nixon (1980) observed that there is little direct evidence that the majority of detritus is exported to the estuary. Wiegert and Freeman (1990) found that marshes can act as sinks or sources for carbon depending on their location, tidal subsidy, and other factors. Haines (1979), Haines and Montague (1979), and Sullivan and Montcrief (1990) demonstrated that edaphic algae are the ultimate food source for marsh fish and invertebrates and that vascular plant detritus serves as an energy source and substrate for benthic microalgae. The central role that detritus may play in the

energetics and/or nutrient processing of the coastal ecosystem is shown in a simplified salt marsh-estuarine food chain (Figure 1).

Mangrove systems are most productive in areas with greater tidal activity, presumably because of the greater input of nutrients (Lugo and Snedaker, 1974; Twilley *et al.*, 1986). In general, red mangroves are the highest net producers, black mangroves are intermediate, and white mangroves are the lowest (Lugo *et al.*, 1975). High primary productivity (1000 to 12,000 g /m² /yr) places mangrove ecosystems among the most productive in the world (Lugo *et al.*, 1975; Bell, 1989; W.E. Odum and McIvor, 1990). Red mangrove leaf biomass varies from approximately 700-800 g/m² in most forest types except scrub forests (W.E. Odum and Heald, 1972). Mangrove detritus has been measured at 1565 g/m² in a fringing mangrove forest in south Florida (Lugo *et al.*, 1976). Since mangroves exist in areas with low wave energy, i.e. depositional environments, they modify the underlying substrate through accumulation of organic matter and formation of peat. Mangrove systems, like other coastal wetlands, probably act as sinks for nitrogen, phosphorus, and other nutrients or pollutants. Although they accumulate nutrients, they also have a continual loss through export of gaseous, dissolved, and particulate forms due to denitrification and tidal flushing (Lugo *et al.*, 1976). While external nutrient sources affect nutrient storage and primary productivity within mangrove systems, internal mechanisms, such as internal recycling of nitrogen in litter, may partially offset the limiting effects of low nutrient inputs in inland and basin mangrove forests (Twilley *et al.*, 1986).

Total animal production in various ecosystems is ranked in Table 4. In areas where plant production is high, animal production is high. Animal production in swamps and marshes (9.0 g C/m²/yr) and estuaries (17.8 g C/m²/year) is higher than production in terrestrial ecosystems (2-3 g C/m²/year) and is only exceeded by algal bed and reef communities (Whittaker, 1975; Turner, 1982). Faunal diversity of coastal wetlands is very high. For example, Subrahmanyam *et al.* (1976) identified 58 taxa of macroinvertebrates in a Gulf coast *Juncus* marsh.

Coastal wetlands also serve as important nutrient processors which provide water-quality maintenance. The ability of wetlands to bind nitrogen and phosphorus is reviewed by Adamus (1983) and Nixon (1980). That function depends upon several attributes, including the capacity of the vegetation, on a net annual basis, to assimilate and transfer to deep sediments more nutrients than are released through leaching and decay. Generally, sediments accrete faster than they are removed, and the rate of denitrification in wetland soils consistently exceeds the rate of nitrogen fixation. Coastal marshes are thought to be net importers of phosphorus and may transform phosphorous into a form more readily available to phytoplankton (Nixon, 1980, 1982; Whitney *et al.*, 1981).

Wetlands have the potential to store water, and therefore play an important role in the control of flood waters. Coastal wetlands that line the tidal reaches of rivers and streams provide storage area for flood waters, decrease stream velocities, reduce peaks during flooding, and influence the duration of floods. Also, wetlands serve to temper the impacts of droughts by holding and slowly releasing water.

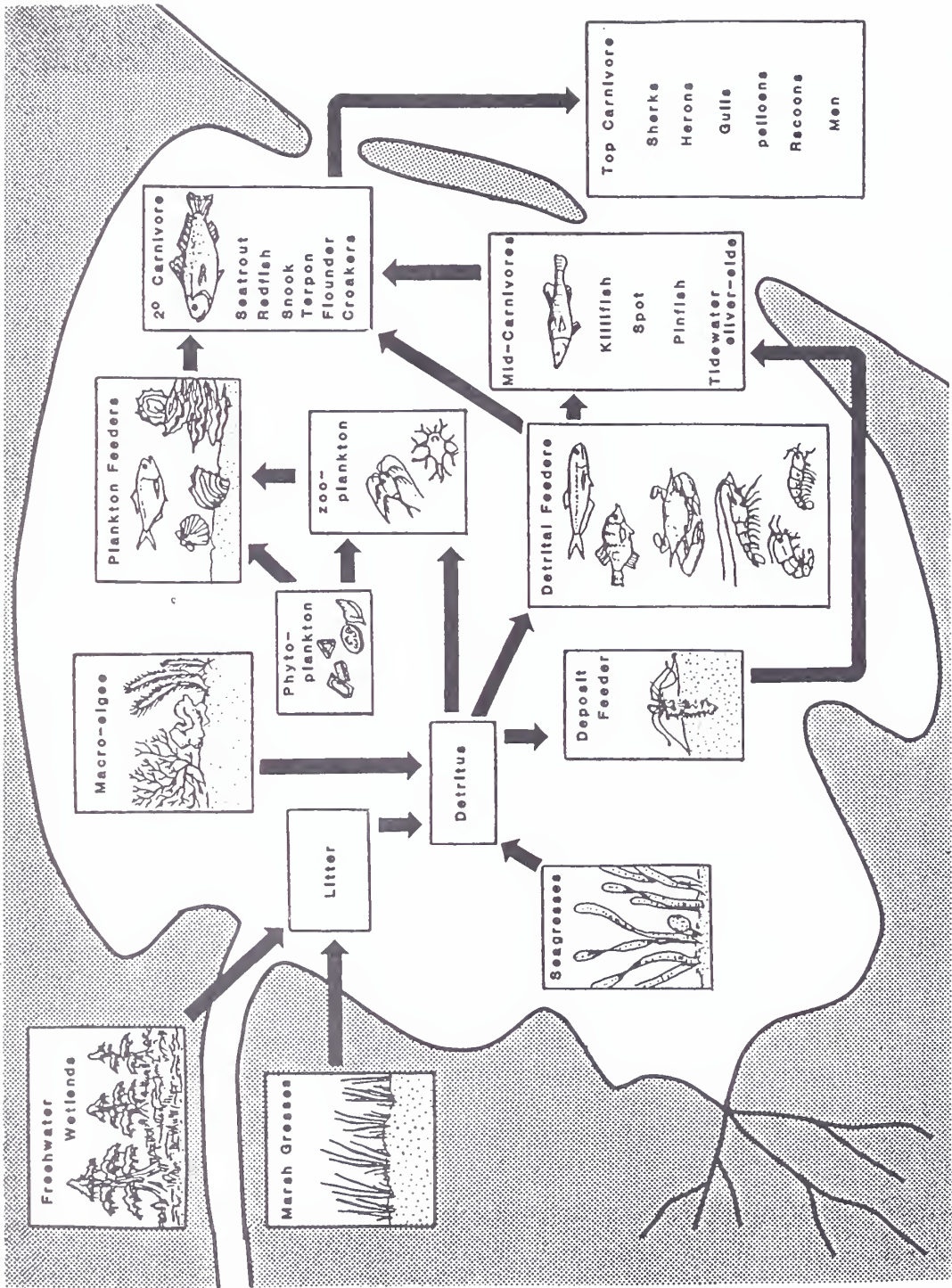


Figure 1. Coastal marsh-estuary food web (from Durako, et al., 1985)

Table 4. Estimates of Animal Secondary Production for Various Ecosystems (Adapted from Whittaker (1975), Turner (1982), and Duke and Kruczynski (1992).

ECOSYSTEM	ANIMAL BIOMASS (g C/m ²)	ANIMAL PRODUCTION (gC/m ² /yr)	% CONSUMPTION PLANT PRODUCTION
Rock, Ice, Sand	0.01	0.0004	2
Desert	0.02	0.15	3
Tundra, Alpine Meadow	0.02	0.20	3
Cultivated Land	0.02	0.03	1
Boreal Forest	2.2	1.4	4
Temperate Evergreen Forest	4.5	2.4	4
Temperate Deciduous Forest	7.0	2.7	5
Temperate Grassland	3.1	3.3	10
Open Ocean	1.1	3.4	40
Tropical Seasonal Forest	5.4	4.0	6
Lake and Stream	2.2	5.5	20
Tropical Rain Forest	9.0	6.5	7
Savanna	6.8	7.0	15
Continental Shelf	9.0	7.3	30
Swamp and Marsh	4.5	9.0	8
Upwelling Zones	4.5	12.5	35
Estuaries	6.8	17.8	15
Algal Bed and Reef	9.0	18.3	15

Coastal environments are dynamic and ever-changing in response to wind, waves, current, sea level, and man's activities. Vegetated shorelines are more stable than unvegetated shorelines because of the ability of plant roots to bind soils. Coastal wetlands also temper wave energy and reduce coastal erosion processes.

Many studies have documented the role of coastal wetlands in fisheries production. Estimates vary, but as many as 95% of commercial fish landed and 85% of sport catches in the Gulf of Mexico spend at least a portion of their life in coastal waters and coastal wetland habitats (Thayer and Ustach, 1981; Thayer et al., 1979).

A total of 90 species of fishes, including many commercially and recreationally important species, have been reported from creeks, ponds, and open waters of coastal marshes of the northeastern Gulf coast (Kruczynski and Ruth, 1997). Subrahmanyam and Drake (1975) and Subrahmanyam and Coultas (1980) analyzed food preferences of common marsh fishes and divided them into detritivores (e.g. *Cyprinodon variagatus*), detritivores/carnivores (*Eucinostomus* spp., *Fundulus* spp.), and carnivores (*Cynocion arenarius*). They observed that feeding strategies of some species change with age.

Shrimp landings are a very important commodity in coastal areas of the United States. Turner (1977) observed that the relationship between shrimp landings and the area of open water is not statistically significant and appears negative. However,

Turner (1977) demonstrated a positive correlation between the weight of commercial shrimp landings and the area of coastal wetlands vegetated by *Spartina*, *Juncus*, or mangroves over a wide geographical area. Landings data from 27 locations were averaged for several years and the annual shrimp yields per acre of intertidal wetland ranged from 10 to 200 kg/ha (8.9 to 178 lb/acre). Of the total amount of shrimp caught in inshore waters, the percentage of brown shrimp (*Penaeus aztecus*) was highly correlated ($r = 0.92$) with the presence of coastal marsh vegetation. Shrimp abundance and landings are also directly related to the kind of wetland vegetation present (Zimmerman *et al.*, 1982, 1984; Minello and Zimmerman, 1985).

The association between shrimp life cycles and coastal wetland acreage is discussed by Turner and Boesch (1988). Causal relationships exist, given reasonable assumptions, between coastal wetland acreage and juvenile abundances, which affect subsequent adult densities. Shrimp recruitment is dependent upon acceptable climatic factors and habitat quality; thus, changes in habitat quality and quantity can be detrimental to shrimp production. Positive correlations were found between annual harvests of penaeid shrimp and coastal wetland areas worldwide. Correlation coefficients between amounts of shrimp harvested and area of wetlands (length of mangrove shorelines or area of intertidal vegetation) were: 0.76 Australia, 0.74 Malaysia, 0.62 Philippines, and 0.97 Gulf of Mexico U.S.A. Turner and Boesch also documented changes in shrimp landings following changes in coastal wetland habitat. Decreases in wetland acreage resulted in decreased quantity of shrimp in Louisiana, Kuwait, Saudi Arabia, El Salvador, and Vietnam. The sharp decline of shrimp yields in Japan were highly correlated with cumulative loss of coastal wetlands ($r = 0.85$).

Turner (1982) observed that although the exact mechanism coupling fisheries productivity and coastal habitat is not always clear, a strong correlation is clearly indicated. He states that if the reported figures of a 1% loss of wetlands per year is equivalent to a 1% decline in the potential fishing yield, then the impact of coastal wetland loss on cumulative loss in dockside dollar value over a 20 year period (1982-2002) would be \$380 million (1982 dollars). The actual economic value could be three times higher than the dockside value as a result of value added during processing and delivery (Jones *et al.*, 1974).

Many other studies have attempted to place a market value on coastal wetland acreage based on the ecological links between wetlands, fishery landings or other values provided by wetlands. For example, Gosselink *et al.* (1974) estimated the value of unaltered wetlands to be approximately \$201,000 per hectare (\$81,500 per acre) (1974 dollars) using a "life-support" valuation that calculated the economic value of the products of wetlands, including the market value of estuarine-dependent species, as well as sales of fur-bearing animals. Assuming a discount rate of 5% per year, the value of one hectare of marsh is \$10,000 per year in perpetuity (Bell and Lynne, 1997). Criticisms of that technique include the assumptions that fish harvest is solely linked to wetland acreage, whereas fish catch also depends on biomass and fishing efforts. Also, the method assumed that all wetland acreage is equally productive (Bell and Lynne, 1997).

Batie and Wilson (1978) attempted to correlate economic values from oyster production with acreage of adjacent tidal marsh and developed a bioeconomic model to define the contribution of wetlands to oyster production. Using that model, they calculated the marginal value products and capitalized values from oyster harvesting accruing to wetlands in seven Virginia counties.. They found that their values do not compare favorably with the value of wetlands for development. For example, the discounted marginal value associated with residential development of Virginia Beach wetlands is approximately \$43,000 per hectare (\$17,650 per acre) (1978 value), whereas the model suggests a wetland marginal value of \$116 per hectare (\$47.11 +/- \$1,402.33 per acre) if wetlands are preserved for oyster production. When other possible values of the wetlands, such as erosion control, wildfowl habitat, or fishery nursery are added, the amount may or may not exceed the average value to development; they did not perform that analysis because of the difficulty in collecting reliable data on the real value of other wetland functions.

H.T. Odum (1967, 1996) proposed that the value of wetlands can be facilitated by using energy units as the common denominator of economic and environmental exchanges. H.T. Odum and Hornbeck (1997) used data from coastal marshes of north Florida to estimate the contributions of marsh production and storage to real wealth using EMERGY, a measure of environmental work expressed in solar emjoules. Macroeconomic dollar value of a product is defined as the dollars of the gross economic product based on the EMERGY of that product. Macroeconomic value is that proportion of the dollars of gross economic product based on a comparison of total EMERGY to the total annual EMERGY. H.T. Odum and Hornbeck (1997) made that calculation on two scales: (1) for a hectare of typical marsh, and (2) for an overview of a coastal region in which salt marshes were contributing to the economy.

Values of coastal marshes using various economic valuation techniques are given in Table 5. Using EMERGY valuations, the macroeconomic values of *Spartina* (\$660/ha/yr = 260/ac/yr) and *Juncus* (\$743/ha/yr = 297/ac/yr) are larger than some estimates obtained from other economic evaluations that only measure single services to humans.

Using Cedar Key, Levy County, Florida as a model, H.T. Odum and Hornbeck (1997) argue that a hectare of marsh has the direct macroeconomic value of its direct EMERGY contribution plus an economic match based on a ratio of purchased EMERGY to free environmental energy. Using that logic, they calculated that the actual macroeconomic value of coastal marsh to the Cedar Key economy is \$1341/ha/yr (\$543/ac/yr). Since Levy county has a low ratio of purchased EMERGY to free environmental energy (0.61), they concluded that the potential public value that depends on coastal marshes is \$5839/ha/year (\$2,364/acre/yr).

Bell (1989) and Bell and Lynne (1997) studied the importance of estuarine wetlands to commercial and recreational marine fisheries in Florida. Coastal wetlands were found to be linked to approximately 80% of the total weight of fish landed by recreational fishermen, and nearly 92% of Florida's commercial landings (Bell, 1984). Their approach to determine tangible value of wetlands involves assigning a monetary value to harvestable products and dividing the market value

Table 5. Some Estimates of Salt Marsh Economic Value (\$/ha/yr).

Value (\$/ha/yr)	Valuation Base	State	Reference
<u>Single Function</u>			
\$116	oyster production	VA	Batie & Wilson, 1978
\$101	waterfowl	GA	Reimold <i>et al.</i> , 1980
\$89	fisheries	FL	Bell, 1989
\$870	fisheries	FL	Bell & Lynne, 1997
\$17-\$57	hurricane winds	LA	Farber, 1987
\$89	recreation	LA	Bergstrom <i>et al.</i> , 1990
<u>Complete Value</u>			
\$10,000	fisheries, aquaculture, water treatment	LA	Gosselink <i>et al.</i> , 1974
\$1,560	coal equivalents	-	Farber & Costanza, 1987
\$660	EMERGY- <i>Spartina</i>	FL	Odum & Hornbeck, 1997
\$743	EMERGY- <i>Juncus</i>	FL	Odum & Hornbeck, 1997
\$1,341	actual macroeconomic value	FL	Odum & Hornbeck, 1997
\$5,839	potential macroeconomic	FL	Odum & Hornbeck, 1997
\$14,785	ecosystem services	world	Costanza <i>et al.</i> , 1997
<u>Restoration Costs</u>			
\$115,000	replacement 20-year old mangroves	FL	Hoffman, 1986

of the products by total acreage of wetlands to establish a dollar value per acre. A production function was determined for eight estuarine-dependent species: blue crab, stone crab, grouper, red drum, oyster, spiny lobster, shrimp, and black mullet. The results indicated a strong statistical correlation between catch, fishing effort, and salt marsh acreage. The marginal product model calculates the retail value of an acre of salt marsh to commercial fisheries on the west coast of Florida at \$870/ha/yr (\$353/ac/yr).

Not all of the proposed valuations of wetlands are based on their value to fisheries. The cost of replacing a wetland can be used as an estimate of the minimum economic value of wetlands. For example, the average price of planting mangroves is about \$24,700 per hectare (\$10,000 per acre), which includes the costs of plants and labor. The replaced area of newly planted mangrove trees does not provide the same functions as a mature mangrove forest. Thus, interest on the \$24,700 over 20 years to maturity must be added to the cost. At an interest rate of 8% per year, the replacement value would be \$115,000 per hectare (\$46,610 per acre) (Hoffman 1986 as cited in Bell and Lynne, 1997).

Farber (1987) estimated the value of coastal wetlands for protection of coastal communities from hurricane winds. The basis for this protection is that wetlands help to weaken storms and provide a vegetated buffer between the storm and populated areas. As a hurricane makes landfall, the central core weakens as it passes over flat coastal terrain because the core is no longer fueled by the ocean heat source. Also,

it is possible for wetlands to diminish the inland tidal surge that results from a hurricane impacting the coastline because of the effects of marshlands on wave energy and the reservoir capacity of the intervening area. Farber developed a model to estimate the effects of wind damage of coastal Louisiana. The value of the loss of 1.6 km (1 mi) depth of coastal wetlands along the Louisiana coast was estimated for each Louisiana parish. The total incremental annual damages from the loss of 1.6 km (1 mile) of wetlands along the 403 km (250 mi) coast was \$63,676 per year (1988 costs). When the annual incremental damage is capitalized, the value (1980 dollars) of increased wind damage is between \$1.1 and \$3.7 million. On a per-hectare basis, this amounts to between \$17 and \$56 per hectare (\$7 to \$23 per acre). The market value of Louisiana wetlands is approximately \$500 per hectare (\$200 per acre) which is derived primarily from mineral and hunting rights.

Farber suggests that hurricane protection is only one of several functions that wetlands produce as "public goods". Flood damage is probably more damaging to low-lying coastal areas than wind, and wetland areas may be more useful for flood protection than wind protection. That relationship remains to be quantified.

To achieve an estimate of the full value of wetlands, their value for wind protection must be added to other socio-economic values, as well as their fish and wildlife and environmental quality values (Table 2). All the goods and services provided by wetlands must be examined and considered when decisions are made on costly projects to revegetate or otherwise protect wetlands. Also, the same concept applies when decisions are made to destroy wetlands through canal construction and other developments.

Two recent studies have calculated the environmental and economic benefits of healthy ecosystems and biodiversity to the world economy. Costanza *et al.* (1997) estimated the current economic value of 17 ecosystem services provided by 16 biomes. For the entire biosphere, their value is estimated to average a minimum of \$33 trillion/year, while the global gross national product total is about \$18 trillion per year. One way to look at that comparison is that the global GNP would have to be increased by at least \$33 trillion, partly to cover services already captured in the existing GNP and partly to cover services not captured in the GNP. If ecosystem services were actually paid for in terms of their value contribution to the global economy, the global price system would be very different from what it is today. Ecosystem services provided by coastal wetlands include disturbance regulation, waste treatment, habitat, food production, raw materials, and recreation. Costanza *et al.* (1997) estimated the value of coastal wetland ecosystem services to be \$14,785/ha/year (\$6000/ac/yr) (Table 6).

Pimentel *et al.* (1997) analyzed the vital services provided by all biota (biodiversity) and observed that the rapidly growing world population and increased human activities has accelerated extinction rates approximately 1000 to 10,000 times higher than natural extinction rates due to pollution or depletion of resources on which biological services are based. They assessed the economic and environmental benefits of the following major contributions of biodiversity: organic waste disposal, soil formation, biological nitrogen fixation, crop and livestock genetics, biological pest control, plant pollination, and pharmaceuticals. They

Table 6. The Value of Ecosystem Services (from Costanza *et al.*, 1997).

SERVICES	ECOSYSTEM						
	OPEN OCEAN	ESTUARIES	SEAGRASS	CORAL REEFS	WETLANDS	TIDAL MARSHES	CROPLAND
GAS REGULATION	38				133		
CLIMATE REGULATION							
DISTURBANCE REGULATION		567		2750	4539	1839	
WATER REGULATION					15		
WATER SUPPLY					3800		
EROSION CONTROL							
SOIL FORMATION							
NUTRIENT CYCLING	118	21110	19002				
WASTE TREATMENT				58	4177	6696	
POLLINATION							14
BIOLOGICAL CONTROL	5	78		5			24
HABITAT/REGUGIA		131		7	304	169	
FOOD PRODUCTION	15	521		220	256	466	54
RAW MATERIALS		25	2	27	106	162	
GENETIC RESOURCES							
RECREATION		381		3008	574	688	
CULTURAL	76	29		1	881		
TOTAL \$VALUE/HA/YR	\$252	\$22832	\$19004	\$6075	\$14785	\$9990	\$92
GLOBAL VALUE/YR X 10 ⁹	\$8381	\$4110	\$3801	\$375	\$4879	\$1648	\$128

estimated that in the United States, biodiversity contributes an estimated \$319 billion per year which is about 5% of the gross domestic product (\$6 trillion per year). For the world, the benefits are estimated to be \$2928 billion per year or approximately 11% of the world economy (\$26 trillion per year). The authors stress that this assessment should serve as a foundation to develop strategies and policies to preserve biological diversity and maintain ecosystem integrity.

Since coastal wetlands provide many public values, and so many acres of coastal wetlands have been historically lost, it is reasonable to conclude that the value of those wetlands remaining is high. Roe and Ayres (1954) estimated the original wetland acreage of the conterminous United States (excluding Hawaii and Alaska) to be 87 million ha (215 million ac). Wetland area remaining in the 1970's was estimated by Frayer *et al.* (1983) to be 40 million ha (99 million ac), a loss of 54%.

Dahl (1990) performed a similar analysis and estimated the change in wetland acreage in the United States from the 1780's to the 1980's. He concluded that at the time of Colonial America, the lower 48 states had 89 million ha (221 million ac) of wetlands and lost an estimated 42 million ha (104 million ac) (53%) by the 1980's (47 million ha remaining) (117 million ac). In 1780, Alaska had 69 million ha (170 million ac) and Hawaii had 24,000 ha (59,000 ac). In the 200 year period of that study, Alaska and Hawaii lost 1% and 12% of wetlands respectively (Table 7).

Among the lower 48 states, ten states have lost more than 70% of their original wetland acreage and 22 states have lost 50% or more (California -91%; Ohio -90%; Iowa -89%; Indiana -87%; Missouri -87%; Illinois -85%; Kentucky -81%; Connecticut -74%; Maryland -73%; Arkansas -72%) (Table 7). Florida has lost the most acreage (3.8 million ha; 9.3 million acres) (Dahl, 1990). The status and trends of Florida wetlands are described by Frayer and Heffner (1991) and the status and trends of wetlands of the southeast are described by Heffner *et al.* (1994).

The Emergency Wetlands Resource Act of 1986 requires the U.S. Fish and Wildlife Service to update the status and trends of wetlands in their conterminous United States on a ten year cycle. Dahl *et al.* (1991) concluded that there were approximately 43 million ha (105.9 million ac) of wetlands in the mid-1970's. In the mid-1980's there were 42 million ha (103.3 million ac) which represents a loss of over 1 million ha (2.6 million ac) during that decade. Freshwater wetlands experienced 98% of the losses. In the mid 1980's, Dahl *et al.* estimated that 40 million ha (97.8 million ac) of freshwater wetlands and 2.2 million ha (5.5 million ac) of estuarine wetlands remained.

Field *et al.* (1991) used aerial photographs and National Wetland Inventory Maps to estimate the remaining acreage of wetlands within estuarine watersheds (drainage basins) for each coastal county (507) and coastal state (22). Thus, they included more wetland types in their estimate of coastal wetlands than Dahl *et al.*'s estimate of "estuarine" wetlands. Field *et al.* (1991) estimated that there are approximately 11 million ha (27.4 million ac) of wetlands in the Nation's coastal areas, which accounts for approximately one third of the total wetland acreage. Forested and scrub-shrub wetlands are the most abundant coastal wetland type in the U.S. accounting for 63% of the national total. Coastal wetlands are not evenly distributed among coastlines. The Gulf of Mexico region accounts for 51% of all coastal wetlands, 61% of coastal fresh marsh, 58% of salt marsh and 47% of forested and scrub-shrub wetlands.

Florida has the most coastal wetlands among states with nearly 4 million ha (10 million ac) (36% of the Nations total). Most of those wetlands (72%) are located on Florida's Gulf coast. When combined with the 1.3 million ha (3.3 million ac) of coastal wetlands in Louisiana, those two states alone account for 49% of the total acreage of coastal wetlands in the U.S.

Major causes of wetland losses are discussed by Zinn and Copeland (1982) and Gosselink and Baumann (1980). The high rate of loss of wetlands between 1950 and 1970 (approximately 3.6 million ha) is attributed to post war agriculture and development (Gosselink and Baumann, 1980; Tiner, 1984). Conversion of wetlands for agriculture was responsible for 87% of the losses, particularly forested wetlands

Table 7. Wetland Losses in the United States from 1780's to 1980's (from Dahl, 1990).

STATE	% WETLANDS LOST	STATE	% WETLANDS LOST
AL	-50%	NV	-35%
AZ	-36%	NH	- 9%
AR	-72%	NJ	-39%
CA	-91%	NM	-33%
CO	-50%	NY	-60%
CT	-74%	NC	-49%
DE	-54%	ND	-49%
FL	-46%	OH	-90%
GA	-23%	OK	-67%
ID	-56%	OR	-38%
IL	-85%	PA	-56%
IN	-87%	RI	-37%
IA	-89%	SC	-27%
KS	-48%	SD	-35%
KY	-81%	TN	-59%
LA	-46%	TX	-52%
ME	-20%	UT	-30%
MD	-73%	VT	-35%
MA	-28%	VA	-42%
MI	-50%	WA	-31%
MN	-42%	WV	-24%
MS	-59%	WI	-46%
MO	-87%	WY	-38%
MT	-27%	AK	-0.1%
NE	-35%	HA	-12%

in the Mississippi River floodplain and prairie pothole wetlands . Urban development and other development caused approximately 8% and 5% of the losses, respectively. Coastal wetland losses for that 20 year period were greatest in the Gulf states, Louisiana, Florida and Texas. Most of Louisiana's coastal marsh losses were attributed to subsidence and submergence by coastal waters. In other areas, urban development was the major direct man-induced cause of coastal wetland loss. Dredging and filling activities in coastal areas was most significant in Texas, New Jersey, New York, and California (Tiner, 1984).

Significant historic and continuing wetland losses are occurring in the Mississippi River deltaic plain. The development of the river delta is a dynamic process that involves both accretion and erosion of sediments. Subsidence in marsh areas is usually not a significant concern because of continued deposition of new sediments which result in a net land-building process. However, upstream dams selectively

remove the coarser sediments resulting in less material available for the natural delta-building processes. Also, extensive navigation canals have allowed intrusion of salt water deep into the estuary, which often results in the death of salt-intolerant vegetation (Gosselink, 1984). Dredged canals also act as a direct route out of the marsh for finer sediments that historically were deposited and accreted in wetland areas.

Turner (1990) observed that the majority of wetland losses are due to drowning of plants under increased water depth and that vegetated habitats are converted to open waters at an annual rate of 0.86%. Gosselink (1984) estimated the annual loss of delta marshes to be 1.5%. Regardless of the discrepancy in rate, both authors agree that the rate of marsh loss to open water has accelerated over the past 50 years and that human activities have interfered with the cycle of delta formation and accretion. Dunbar *et al.* (1990) and Barras *et al.* (1994) reported that the current wetland loss rate is between 65 and 91 km²/yr (25 and 35 mi²). Causes and mechanisms of changes in wetland acreage include: direct loss to dredging construction, filling, erosion and machinery (marsh buggies); subsidence from loss of sediment accretion, oil and gas withdrawal, and soil drying; changes in quantity and quality of vegetation from changes in organic deposition and sediment trapping; and death of plants from pollutants and exotic species.

Linear shoreline retreat rates and aerial land changes were evaluated to establish trends which document the continuing and accelerating rates of land loss along most of coastal Louisiana. Morgan and Morgan (1977) determined the rate of shoreline changes throughout coastal Louisiana through a comparison of 1969, 1954, and 1932 aerial photography. They found that areas of land loss have far exceeded areas of new land formation. Louisiana's shoreline has retreated at an average linear rate of approximately 3 m/yr (10 ft/yr) for the past 37 years. However, that average reflects an increase from about 2 m/yr (6.5 ft/yr) in the interval between 1932 and 1954, to 5 m/yr (17 ft/yr) during the period from 1954 to 1969.

Problems in the Barataria Basin area of coastal Louisiana are typical of this vast network of estuaries and wetlands. Conner and Day (1987) described the ecology and loss of wetlands in the Barataria Basin. This area is a network of interconnecting water bodies that allow transport of water and organisms throughout the basin. High ground within the wetlands is occupied by natural and artificial levees that are surrounded by swamp forests, fresh, brackish, and salt marshes. These productive wetlands provide valuable nursery habitat for fish, shellfish, wintering waterfowl, and fur-bearers. The basin is undergoing changes in the amount of open water and wetland habitats due to subsidence, erosion, and human activities. The latter have altered the natural hydrologic patterns and may cause long-term significant modifications of wetland habitats.

Sasser *et al.* (1986) conducted a computer analysis to compare land and water areas of Barataria Bay, Louisiana by comparing aerial photographs taken in 1945, 1956, 1969, and 1980. They concluded that the rate of marsh loss has increased from 0.36% per year in 1945-56, to 1.03% per year in 1956-69, and to 1.96% per year in 1969-1980. Patterns of marsh loss were not uniform. Marsh loss rates were highest where fresh water marshes have been subjected to saltwater intrusion. The

increase of wetland loss rates corresponds to accelerated rates of subsidence and canal dredging and a cumulative increase in the area of canals and spoil deposits.

Several studies have demonstrated that alteration of normal hydrologic conditions can affect structure and productivity of coastal wetlands. Mendelssohn *et al.* (1982) reported that hydrologic modifications of salt marshes cause increased water logging that may affect plant productivity. Allen (1975) found that standing live *Spartina* biomass was 50% lower in marshes surrounded by spoil banks along canals dug for access to drilling sites, than in a comparable control site. Spoil banks along canals also contain canal flow and restrict the natural lateral transport of water necessary for removal of wastes, the replenishment of marsh sediments, and the import of new nutrients to the wetland. Obstruction of over bank flooding by levees can result in nutrient starvation and block substrate accretion.

Barataria Basin has experienced an annual increase in salinity of 0.108 ppt from 1961 to 1974. Ultimately, the entire basin may become an open water brackish bay or sound unless Mississippi River flow is reintroduced into the area. Intrusion of salt water as a result of diversion of freshwater has resulted in a decline of diverse swamp forests and an increase in monotypic marshes and open water habitat (Van Sickle, *et al.*, 1976). The total number of plant species for each wetland type in Louisiana is: swamp, 200; fresh marsh, 154; brackish marsh, 23; saline marsh, 25) (Conner *et al.*, 1986). Loss of biodiversity has affected ecosystem functions of the area.

Management

With over half of our wetlands already lost, it is imperative that our remaining wetlands be protected and that as many previously destroyed wetlands as practical be restored. Development of coastal wetlands is currently regulated by state and federal permitting programs. Although there is an increasing awareness of their value to society, as the human population increases, the pressure on all aesthetically desirable land (e.g., waterfront) will increase as land becomes even more valuable for commerce and recreation. Also, more and more people are relocating to coastal counties, particularly in the southern portion of the U.S. Culliton *et al.* (1990) predicted that from 1960 to 2010, the coastal population will have grown from 80 million to more than 127 million people, an increase of almost 60%. In 1990, approximately 110 million people, over one-half of the total U.S. population, lived in coastal areas. Coastal development not only directly destroys natural habitat, it also significantly degrades adjacent natural systems by altering shorelines, drainage patterns, vegetation, and wildlife corridors (Williams *et al.*, 1991).

Florida's population is growing by an estimated 1000 people per day (Bureau of Economic and Business Research, 1988). Culliton *et al.* (1990) predicted that the population of Florida will increase from 5 million in 1960 to more than 16 million in 2010 (226% increase). The Miami area alone (Dade, Broward, Palm Beach Counties) will grow by 1.2 million people by 2010. Continued population growth in coastal areas will result in increased crowding of this relatively small, but densely populated portion of the Nation which will undoubtedly put more developmental pressures on remaining coastal wetlands.

While it is probable that large environmental atrocities, such as dredging and filling over 2500 acres of mangroves at Marco Island, Collier County Florida, for residential development (Patterson, 1986) may be a thing of the past, coastal wetland development will continue in areas where coastal wetlands are not in public ownership. Public ownership may be the only sure way of truly protecting wetland resources. The federal wetland program, and most state and local wetland programs, are "permitting" programs, not "preservation" or "protection" programs. Federal and most state and local regulatory agencies issue permits for wetland development when it is determined to be in the public interest, and the definition of "public interest" can vary widely. Increased population in coastal areas will undoubtedly result in the need for more public amenities (schools, parks, churches, etc.) that are often perceived to be in the public interest; proposals to site these amenities in wetlands are common.

Many wetland regulatory programs have followed the lead of the federal program (Section 404 of the Clean Water Act) and have adopted a "no net loss" policy for permitting wetland development. That policy requires compensating for permitted wetland losses by creating, restoring, or enhancing other wetlands (compensatory mitigation). Factors to be considered in preparation of compensatory mitigation plans have been summarized by Kruczynski (1990).

In theory, compensatory mitigation can directly offset adverse effects of wetland losses. Creation, restoration, and enhancement of coastal wetlands is possible, but successful projects require skill and commitment that is often lacking (Kusler and Kentula, 1990; Lewis, 1990). Since most compensatory mitigation is performed as a condition of a permit to destroy wetlands, the permittee often has little interest in monitoring and maintaining a project, and some permittees do not implement the required mitigation at all. In one study, Crewz and Lewis (1991) inspected eighteen mitigation projects in Florida. Five of the projects were found to be successful and six were partially successful. Reasons for such a high incidence of failure were improper elevation, slope, drainage, substrates, adequate fertilizer, site design, site access, suitability of nursery stock, planting density, lack of monitoring, and failure to take corrective actions. Permitting agencies are trying to implement more rigorous compliance monitoring of permit conditions, but high workloads prevent thoroughness by regulatory agencies.

Preventing the destruction of wetlands for development is not our only challenge. There are other, often competing, uses of wetlands that may be in the public interest. For example, impounding coastal wetlands has environmental benefits and risks. Many acres of coastal wetlands were historically impounded for mosquito control, rice production, and fisheries production. Salt marsh mosquito impoundments are common along the Atlantic coast of Florida, particularly along the Banana River and Indian River. The demand for mosquito control will increase as Florida's population expands. Use of impoundments minimizes use of toxic chemicals and provides habitat for ducks, alligators, wading birds and other wildlife. However, the value of the salt marsh as a nursery area for estuarine fish and shellfish is significantly reduced. Gradually, mosquito control agencies are accepting open-water marsh management of tidal marshes as an alternative to impoundment. Open-water

management allows periodic return to natural hydrologic cycles and greatly enhances fish and macroinvertebrate populations (Herke, 1979; Gilmore *et al.*, 1981; Gilmore, 1984).

Many of the remaining wetlands in the Mississippi delta are being managed in an attempt to decrease marsh loss and/or increase productivity. Impoundments of marshes yield excellent crops of ducks, fish, and shellfish and have high recreational use (Davidson and Chabreck, 1983, 1989). However, impoundments disrupt normal hydrological cycles and sediment deposition patterns and can lead to conversion of emergent marsh to open water. Herke and Rogers (1989) concluded that marsh management structures (e.g. weirs) placed to slow erosion of marshes do not work, interfere with migratory movements of aquatic organisms and greatly reduce fisheries productivity. Other efforts to prevent or slow the conversion of coastal wetlands to open water include minimizing canal construction, backfilling or plugging canals, removing spoil levees, spraying dredged spoil over marshes (Turner, 1987), soil stabilization, and accelerating plant succession patterns through planting (Good, 1989).

If the current rate of loss of Louisiana's coastal wetlands (65 to 91 km²/yr) continues, an ecosystem that supports 33% of the nation's fishing industry and North America's largest fur-producing area will become extinct. An acceleration of this trend is possible if the predicted global warming results in a significant sea level rise and subsidence continues or increases (Penland *et al.*, 1989). In an effort to stem and reverse these losses, Louisiana has recently developed "Coast 2050", a multi-disciplinary, multiple use approach to managing coastal resources (Pittman *et al.*, 1998; Louisiana Coastal Wetlands Conservation and Restoration Task Force and Wetlands Conservation and Restoration Authority, 1998). It is hoped that this plan will reverse coastal wetland losses while allowing continued use of the resource by multiple stake holders.

Rising sea level will undoubtedly eliminate many acres of remaining coastal wetlands. Relative sea level is rising in Florida between 20 and 40 cm per century (Wanless, 1989). Although the current rate of sea level rise may be slow enough to allow salt marshes to move inland with rising water, many marshes are bounded by seawalls and other development that will restrict their spread landward. Also, many shorelines, such as areas of Florida's northern coasts are bounded by ancient shorelines (relic dunes) that will result in a significant decrease in the width of the intertidal zone (Mehta *et al.*, 1987). Sea level rise should be taken into account in all coastal developmental plans and compensatory mitigation plans, but it is largely ignored (Titus, 1988, 1990; Titus and Narayanan, 1995).

Our challenge is to manage and use coastal wetlands and associated tidal water bodies wisely to assure their survival. Kusler (1983) listed management options for government entities and private landowners of wetlands. Although prepared over sixteen years ago, most of those recommendations are just as valid today as when they were prepared.

Government Options:

1. Develop a consistent national policy to preserve and protect wetlands of national significance.
2. Strengthen federal, state, and local wetlands protection.
3. Ensure proper implementation of existing laws and policies through adequate staffing, surveillance and enforcement.
4. Remove government subsidies which encourage wetland drainage.
5. Provide tax and other incentives to private landowners and industry to encourage wetland preservation and remove existing tax benefits which encourage wetland destruction.
6. Increase wetland acquisition in critical areas.
7. Improve wetland management on federal and state-owned lands.
8. Scrutinize cost-benefit analyses and justifications for flood control projects that involve channelization of wetlands and water courses.
9. Increase the number of marsh creation and restoration projects.
10. Complete the National Wetland Inventory and periodically update these results in problem areas.
11. Increase public awareness of wetland values and status of wetlands through various media.
12. Conduct research to increase our knowledge of wetland values and to identify ways of using wetlands that are least disruptive to their ecology.

Private Options:

1. Rather than drain or fill wetlands, seek compatible uses, such as timber harvest, waterfowl production, hunting leases, etc.
2. Donate wetlands or funds to purchase wetlands to conservation agencies for tax purposes.
3. Maintain wetlands as open spaces.
4. Work in concert with government agencies to educate the public on wetland values.
5. Construct ponds and wetlands in upland areas.
6. Purchase federal and state duck stamps to support wetland acquisition.

Wise management is required so that future generations will have the opportunity to partake in the many benefits that coastal wetlands provide to society. We must not deprive our grandchildren of the experience of viewing the magnificent grandeur of truly wild areas, not marred by the fingerprint of man, such as vast expanses of coastal wetlands. Maintaining these areas in light of developmental pressures and sea level rise is a challenge we must accept; to do otherwise is unconscionable.

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CHANGES IN SEAGRASS DISTRIBUTION AND DIVERSITY: IS THIS A GOOD THING?

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ABSTRACT

Seagrass beds dominate many shallow soft-bottom coastal environments of the SE United States. Consequently, they play an important role in many physical, chemical, geological, as well as ecological processes. Seven species of seagrasses occur in the region, thus species diversity within most seagrass beds is generally low. Seagrass beds are frequently monotypic in stable environments and most beds in the region contain three or fewer species. Species distribution and dominance change in response to a wide variety of natural and human-induced perturbations which can result in an increase in species diversity. *Thalassia testudinum* (Turtle grass), the dominant coastal seagrass in this region, is considered the climax species and is characteristic of stable, oligotrophic high-light conditions. This species is frequently replaced by species such as *Syringodium filiforme* (Manatee grass) or siphonaceous green algae in high-energy physical disturbances known as blowouts. However, following physical perturbations such as dredge and fill operations or propellor scarring, *Thalassia* may be replaced by *Halodule wrightii* (Shoal grass). Disturbances that cause a reduction in light available to seagrasses may result in an increase in seagrass species diversity as a result of recruitment and spread of low-light adapted species into a previously monotypic *Thalassia* bed. Once *Thalassia* is displaced, benthic habitats may become more susceptible to additional changes in species distribution and abundance.

INTRODUCTION

Seagrass beds are conspicuous and often dominant components of the low-energy coastal environments of the S. E. United States. Although seagrasses are an ancient group, dating back to the late Cretaceous, they are characterized by low species diversity (Larkum and Hartog, 1989). Seagrasses include only 58 species in 12 genera, all contained within the sub-class Alismatidae (Kuo and McComb, 1989). The lack of species diversity coupled with the antiquity of this group has led some to propose that an extremely low rate of evolution has occurred due to the relative stability of aquatic environments (Les, 1988; Cox and Humphries, 1993; Les *et al.*, 1997).

Seagrass species distribution is influenced by environmental factors such as temperature, salinity, water and sediment depth, water transparency and water motion (Zieman, 1972; McRoy and McMillan, 1977; Bulthuis, 1987; Dennison 1987; Fonseca and Kenworthy, 1987). Increases in nutrient levels can lead to changes in species composition and can change trophic dynamics within seagrass ecosystems (Fourqurean *et al.*, 1995). Several studies have correlated changes in seagrass species distribution and abundance with rapidly growing human populations and the associated changes in nutrient levels (Cambridge and McComb, 1984; Cambridge *et al.*, 1986; Orth and Moore, 1991; Pulich and White, 1991). Species diversity in

plant communities may also be influenced by the spatial heterogeneity of nutrients within these ecosystems (Tilman 1982).

Seven species of seagrasses occur in the southeast United States and Gulf of Mexico (Moffler and Durako, 1984). *Thalassia testudinum* Banks ex König, Turtle grass, is the dominant seagrass in tropical and subtropical oligotrophic waters (Zieman 1982, Zieman and Zieman, 1989). *Syringodium filiforme* Kützinger, Manatee grass, is the only seagrass genus with terete (cylindrical) blades and it is characteristic of clear waters with higher tidal currents. *Halodule wrightii* Ascherson, Shoal grass, is a colonizing species which is tolerant of disturbances and it is frequently found at shallow edges of seagrass beds and along wave-beaten bars. There are three species of the small-bodied genus *Halophila* found in this region. *Halophila engelmanni* Ascherson, Star grass, commonly occurs in lower light environments, or as an understory species. *Halophila decipiens* Ostenfeld, Paddle grass, forms extensive beds in deeper waters of the west Florida shelf, in the Big bend region of the Gulf of Mexico, and in Indian River Lagoon. *Halophila johnsonii* Eiseman, Johnson's Seagrass, is very small and may have the most restricted distribution of any seagrass in the world. It is only found from Indian River between Sebastian Inlet and north Biscayne Bay on the East coast of Florida. *Halophila johnsonii* also has the distinction of being the only marine plant that has ever been listed under the Endangered Species Act (Federal Register 1998). *Ruppia maritima* L., Widgeon grass, is a cosmopolitan species that grows and reproduces in conditions ranging from freshwater granitic lakes in Minnesota to hypersaline lagoons in Australia.

Thalassia testudinum, *Syringodium filiforme*, and *Halodule wrightii* can co-occur throughout the southeast United States, however, under stable conditions, one species is usually dominant in any given area (Dawes *et al.*, 1985; Iverson and Bittaker, 1986; Williams, 1990; Short *et al.*, 1990). In south Florida, 40% of 1207 sites surveyed during 1996-1998 over a 19,402 km² area had only one seagrass species present and only 1.2% of these sites had 4 or more species (Fig. 1, Fourqurean *et al.* in press). The number of species that are involved in successional sequences in this region are remarkably few because there are so few species that can colonize unconsolidated sediments (Zieman, 1982). In the absence of disturbance *Thalassia* is the typical climax species in this region (Fig. 2). Williams (1990) reported that *Thalassia* was the climax species when biological factors controlled community structure, but that *Syringodium* was more dominant under low sediment nutrient-supply conditions. Fourqurean *et al.* (in press) hypothesized that *Syringodium* may be able to outcompete *Thalassia* in areas of high phosphorus availability. *Halodule*, a rapid colonizer, is considered the pioneer species in the Caribbean (Zieman, 1982), and it may become dominant under conditions characterized by frequent disturbance or when physical factors are extreme (Zieman *et al.*, 1989). In areas that are subjected to continuous or repeated disturbances, successional development may be constrained and mixed-species communities may result (Zieman, 1982).

Thalassia testudinum is frequently the dominant seagrass despite it's limitation to relatively shallow oligotrophic waters due to high light requirements (Fourqurean

and Zieman, 1991). *Thalassia* meadows are thought to be maintained primarily through asexual vegetative reproduction via rhizome growth (Zieman, 1982; Zieman and Zieman, 1989), although recent genetic work has attributed a greater importance for sexual reproduction (Schlueter and Guttman, 1998; Kirsten *et al.* 1998). Individual short-shoots (ramets) of *Thalassia* can live over 10 yrs (Gallegos *et al.* 1992, 1993; Durako 1994) and the life span of individual plants (genets) is presently unknown, although it may well exceed a century. Thus, under stable conditions large monospecific beds of *Thalassia* may develop (Zieman, 1982).

In this paper I am going to present several examples where the abundance of one seagrass has declined and seagrass species diversity has increased within communities as a result of disturbance or stressful conditions. Seagrass abundance, particularly the abundance of *T. testudinum*, is a valuable ecological indicator and to a large extent determines public perception regarding the “health” of the many shallow coastal ecosystems (Goerte 1994; Boesch *et al.* 1995). Thus, any change in the species distribution or abundance may reflect or be perceived as a change in the health of the ecosystems. The examples provided herein will indicate in that in these shallow-water long-lived clonal communities a change in abundance or increase in species diversity is not necessarily desirable.

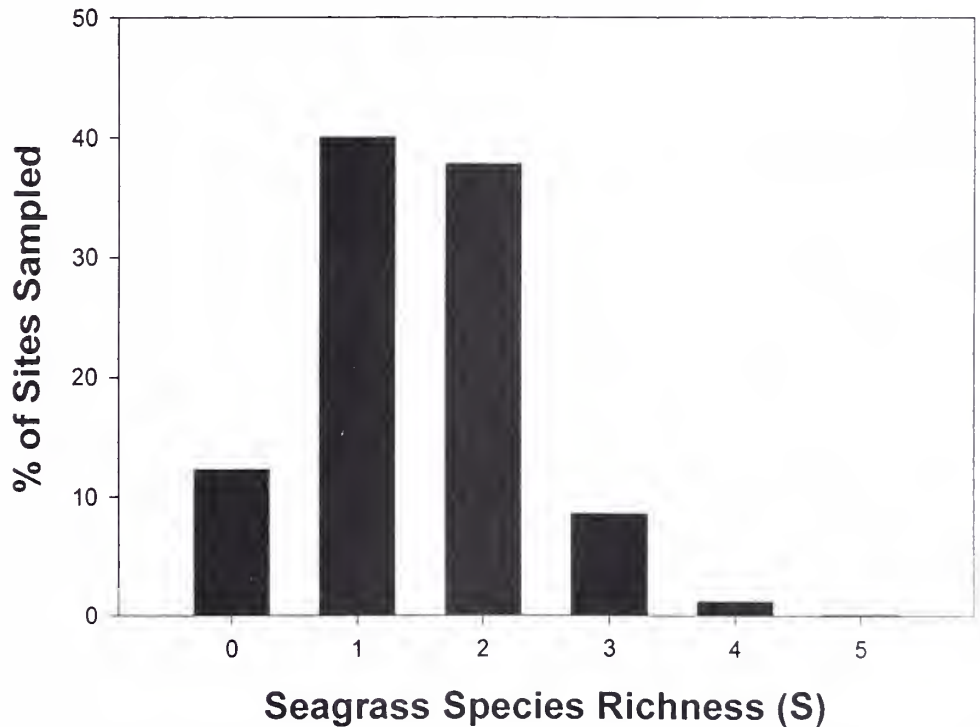


Figure 1. Frequency histogram of Species Richness (S), defined as the number of species at a sampling site, for 1207 sites distributed across south Florida's coastal waters (adapted from Fourqurean *et al.*, in press).

Seagrass Ecosystem Development

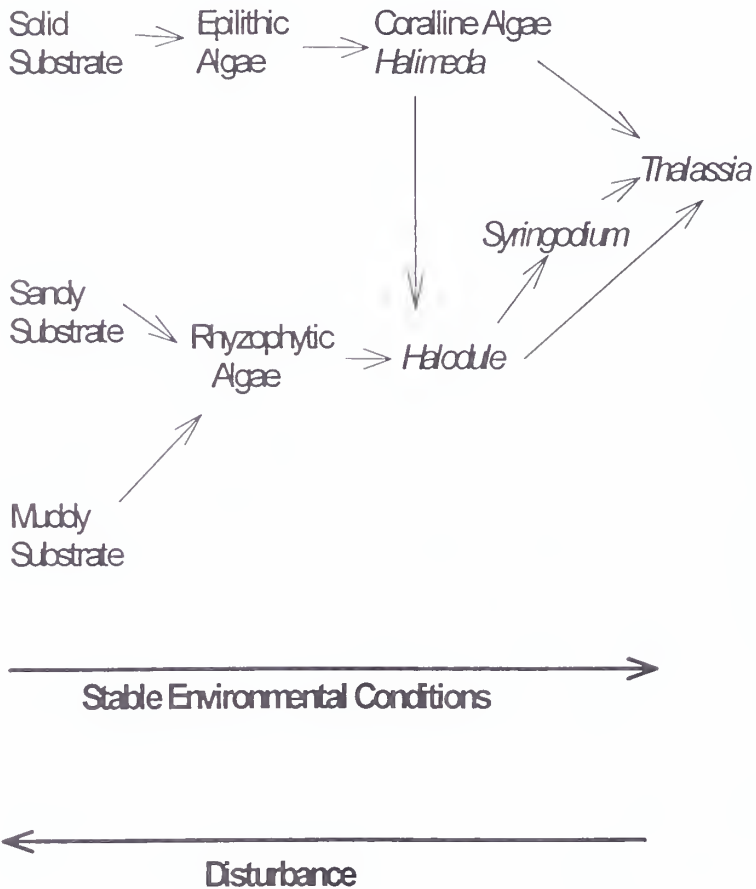


Figure 2. Generalized patterns of seagrass ecosystem development in south Florida (adapted from Zieman, 1982).

SOME EXAMPLES OF CHANGES IN SPECIES DIVERSITY

Nutrient enrichment

In a series of papers investigating evidence for nutrient limitation in seagrass growth and the effects of nutrient enrichment on seagrass communities, Powell *et al.* (1989, 1991) and Fourqurean *et al.* (1995) observed a change from a largely monospecific *Thalassia* dominated community to a *Thalassia*-*Halodule* mixed-species community to *Halodule* dominance following 8 years of nutrient enrichment

(Fig. 3). In this investigation, widely known as the “Bird Stake Study,” nutrients were supplied to a seagrass community on a carbonate mudbank in Florida Bay by placing PVC pipes with wooden blocks on top at 100m intervals along Cross Bank in Florida Bay. These pipes were used as roosting sites primarily by two species of seabirds, Royal Terns, *Sterna maxima*, and Double-crested Cormorants, *Phalacrocorax auritus*. This roosting resulted in the area around each stake receiving supplementary nutrients in the form of bird excrement.

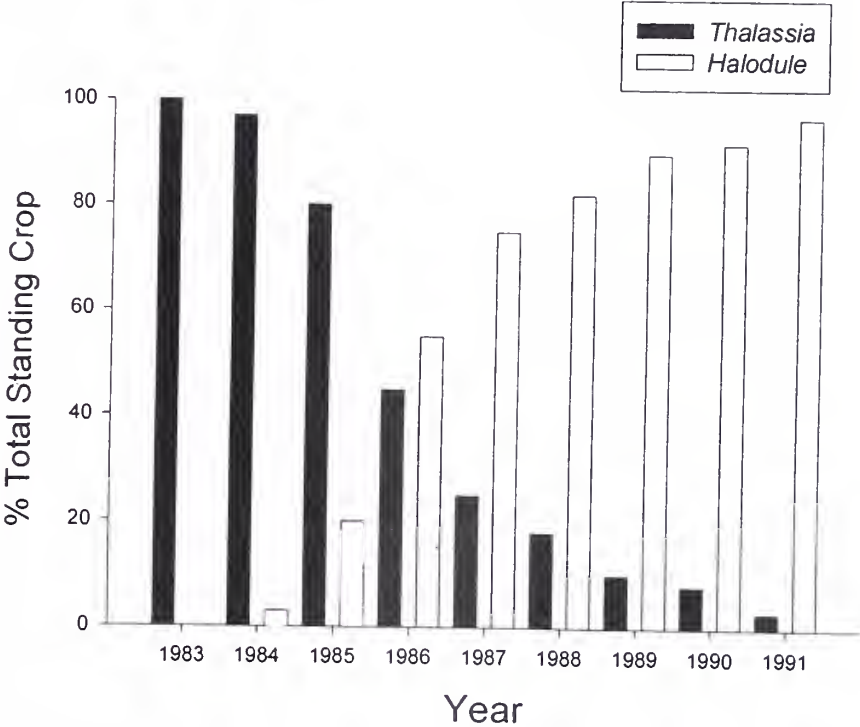


Figure 3. Average proportion of *Thalassia testudinum* and *Halodule wrightii* at sites receiving nutrient additions from bird stakes (adapted from Fourqurean *et al.*, 1995).

Before the stakes were installed in 1983, 100% of the standing crop of the site was *Thalassia* (Fig. 3). The standing crop of *Thalassia* doubled after one year of fertilization. However, *Halodule* also began to appear after only one year of nutrient enrichment. As *Halodule* became established and began replacing *Thalassia*, the size of the remaining *Thalassia* shoots declined. By 1991, *Halodule* made up 97% of the standing crop at the fertilized sites. In contrast, standing crop at the control sites remained *Thalassia*-dominated.

This study demonstrated that *Halodule* can out-compete *Thalassia* when nutrient availability is increased. Fourqurean *et al.* (1992) found that *Halodule* has a four-fold higher demand for phosphorus than *Thalassia*. Therefore, *Thalassia* should out-compete *Halodule* for nutrients in a nutrient-limited environment which is why the former species dominates under nutrient-limiting conditions in much of Florida Bay and in Caribbean seagrass beds (Williams 1987, 1990). The mechanism for dominance of *Halodule* and *Syringodium* over *Thalassia* under nutrient-enriched conditions seems to be based on direct competition for light. *Halodule* and *Syringodium* both have the ability to exhibit enhanced vertical growth in the form of "aerial runners" (Kenworthy and Schwartzchild 1998). The resulting dense canopies can shade the *Thalassia*, resulting in an inability to maintain a positive carbon balance. This was reflected by the reduction in *Thalassia* shoot size during the later period of fertilization. These experiments provide support for a resource-ratio model where seagrass community species diversity is controlled by resource supply rates (nutrients) to the community (Fourqurean *et al.* 1995; Tilman 1982, 1988).

Blowouts, Dredging, and Prop Scars

Blowouts are grass-free depressions that occur within shallow seagrass beds under moderate-to-high energy conditions (Patriquin, 1975; Wanless, 1981). These depressions have a characteristic crescent shape with the convex, undercut side oriented into the wave energy and a gradually sloping leeward side. Blowouts migrate seaward. This migration results in a successional sequence across the blowout whereby there is a *Thalassia* bed undercut to bare sand (erosional scarp), landward of this is a bare area, then an accumulation area colonized by pioneer species such as *Syringodium* or *Halodule* along with several species of siphonaceous green algae. The leeward edge of the blowout is characterized by a mixed-species seagrass assemblage that typically grades back into a monotypic *Thalassia* bed. Thus, this disturbance first results in a localized reduction in diversity (removal of all seagrasses) followed by increased diversity, with the eventual dominance by the climax species.

Dredging has negative impacts on seagrasses by removal or burial and by lowering the bottom to depths greater than the photic zone (Zieman and Zieman, 1989), but more recent evidence has suggested that light reduction resulting from dredging can also result in seagrass losses or changes in species diversity (Adair *et al.*, 1994; Onuf, 1994). In the lower Laguna Madre, maintenance dredging has been linked to losses of *Halodule wrightii*, the expansion of *Syringodium filiforme*, *Halophila engelmannii*, and *Thalassia testudinum*, and a shift in species dominance from *Halodule* to *Syringodium* over 150 km² of the Bay (Quammen and Onuf, 1993; Onuff, 1994). The losses of *Halodule* have occurred primarily in the deepest portions of the lower laguna, suggesting that reduced water clarity and light limitation were the likely causes. Quammen and Onuf (1993) suggested that the observed species shifts were likely due to altered circulation patterns that resulted from channel dredging.

Prop scarring of seagrasses has long been recognized as a major disturbance (Woodburn *et al.*, 1957; Phillips, 1960; Sargent *et al.* 1995). Prop scarring is a form

of dredging and the scars may share features characteristic of blowouts. Zieman (1976) suggested that small-vessel (i.e., propelled by outboard motors) prop scars in southern Florida *Thalassia* beds take 2-5 years to initiate recovery and may lack cover for as long as 10 years. Likewise, Durako *et al.* (1992) estimated recovery times of 3.6-6.4 years for *Thalassia* in Tampa Bay, but only 0.9-4.6 years for recovery of *Halodule* from prop scarring. They found that the rate of short-shoot regrowth of *Halodule* was 10-20 times higher than that of *Thalassia*. In Tampa Bay, previously monotypic beds of *Thalassia* that are subject to moderate scarring are frequently characterized by having a *Thalassia-Halodule* mixed species assemblage, because of *Halodule*'s higher recovery and growth rates (Durako *et al.* 1992). Blowouts, dredging and prop scarring are repeated disturbances. The results of these disturbances are to constrain successional development within the effected seagrass communities in an intermediate stage with a higher-diversity mixed-species community, rather than allowing the area to develop a more typical monotypic climax community (Zieman, 1982).

Disease

Thalassia testudinum is the dominant seagrass in the high-light low-nutrient environment of Florida Bay (Fourqurean *et al.*, 1995) and historically covered over 90% of the 180,000 ha of subtidal mudbanks and basins within Florida Bay (Zieman *et al.*, 1989). By comparison, mangrove islands cover only about 7% of the Bay. Extensive areas of *Thalassia* began dying rapidly (4,000 ha completely lost, 24,000 ha affected) during the summer of 1987, particularly in central and western Florida Bay (Robblee *et al.*, 1991). Physiological stressors such as elevated water temperature, prolonged hypersalinity, excessive seagrass biomass leading to increased respiratory demands, hypoxia and sulfide toxicity, and an infection by a pathogenic marine slime mold, are some of the factors thought to have contributed to *Thalassia* die-off, however, the causative mechanisms responsible for initiating this disease remain incompletely understood (Robblee *et al.*, 1991; Carlson *et al.*, 1994; Durako, 1994; Durako and Kuss, 1994). The patterns of loss of *Thalassia* in Florida Bay have undergone at least two phases: the first phase being the initial die-off which occurred during the relatively dry and clear-water period of 1987 to early 1991 (Robblee *et al.*, 1991). Following the initial seagrass die-off, which appeared to affect only *Thalassia*, western Florida Bay began exhibiting widespread declines in water clarity which affected species distributions in the Bay (Boesch *et al.*, 1995; Philips *et al.*, 1995; Durako *et al.*, in press; Stumpf *et al.*, in press). The increased light attenuation, which began during the fall of 1991, was principally due to microalgal blooms and resuspended sediments associated with the loss of seagrasses on the western banks, and it has been most severe in the western and central Bay (Philips and Badylak, 1996). Recent data from the USGS has indicated that loss of seagrass cover is a major factor in increases sediment resuspension in the Bay (Prager, 1998).

To monitor the status and trends of benthic macrophytes within Florida Bay, the Fisheries Habitat Assessment Program (FHAP) was initiated during spring 1995 (Durako *et al.*, In press). The goal of FHAP is to provide information for spatial

assessment and resolution of both intra- and inter-annual variability in the seagrass-macroalgae communities. A comparison of seagrass species richness in Johnson Key Basin, one of the chronically turbid regions in western Florida Bay between 1995 and 1998, indicates that the number of species in this basin has steadily increased (Fig. 4). In 1995, only 3 species were present in this basin (*Thalassia testudinum*, *Syringodium filiforme*, and *Halodule wrightii*), *Thalassia testudinum* was the dominant species, and most of the sites within the basin had less than 2 species. The small-bodied, low-light adapted species, *Halophila engelmanni*, was first observed during fall 1996 at one station. By spring 1998, this species was present at 15 of the 32 stations and most of the basin had 2-3 species and areas with 3-4 species were common, reflecting the recruitment of *Halophila engelmanni* to this turbid basin and the spread of *Halodule wrightii*. *Halodule wrightii* increased in abundance by 400% from 1995 to 1998 and it became the dominant species within this basin by spring 1997 (Durako et al., in press).

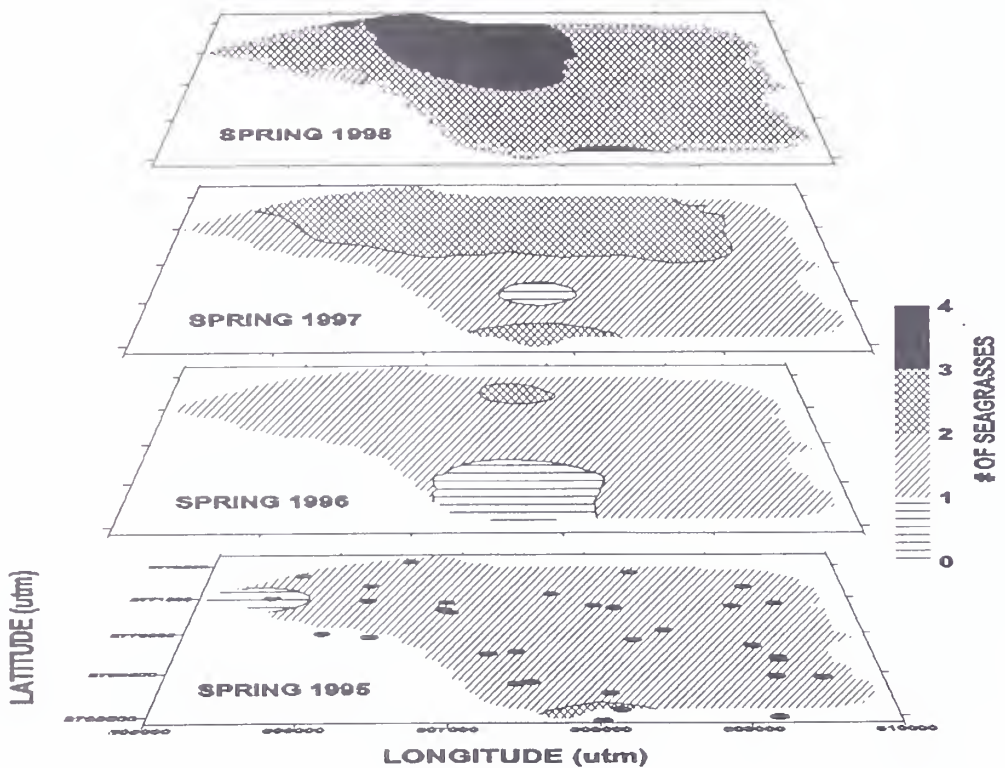


Figure 4. Spatial distribution of seagrass species richness in Johnson Key Basin, western Florida Bay from 1995-1998. Maps of seagrass species distribution were produced by inverse distance interpolation. Small circles on Spring 1995 map represent sampling locations.

Johnson Key Basin is unique in being the only basin sampled by FHAP to exhibit a shift in species dominance from *Thalassia testudinum* to *Halodule wrightii* and the recruitment of the low-light adapted, small-bodied seagrass *Halophila engelmanni*. *Halophila engelmanni* has not previously been reported to occur within Florida Bay (Schomer and Drew, 1982; Zieman *et al.*, 1989; Hall *et al.*, 1999), although Iverson and Bittaker (1986) observed this species southwest of Sandy Key, beyond the Everglades Nation Park boundaries. These authors indicated that *H. engelmanni* only inhabited low energy environments west of the Bay. Fouqurean *et al.* (In press) reported that *Halophila* distribution was restricted to the western portion of the Florida Keys National Marine Sanctuary in water too deep to support *Thalassia*. Increases in the distribution and abundance of the lower-light adapted seagrass *Halodule wrightii* and the recent appearance (Fall 1996) and spread of the small-bodied, low-light adapted *Halophila engelmannii* in western Florida Bay indicate a change to a shade-adapted seagrass community, reflecting the influence of recent chronic turbidity within this basin. The chronic turbidity in this region has also been accompanied by changes in the photosynthetic characteristics of the phytoplankton communities, from 1994-1996 (i.e., increase in α and a decrease in P_{max} , Tomas *et al.*, 1998). The observed changes in photosynthesis versus irradiance responses suggests an adaptation by the phytoplankton to lower light conditions. The reduction in available light in western Florida Bay has shifted the predominant seagrass community in the Bay from monotypic *Thalassia*, with an increase in seagrass species diversity.

SUMMARY

Environmental stresses may result in a change in seagrass species composition and can weaken some species, making them vulnerable to disease (den Hartog 1987, Short *et al.* 1988, Muehlstein 1989). Declining environmental conditions which result in reductions in available light have been implicated in species changes and seagrass declines worldwide (Cambridge and McComb 1984, Dennison *et al.* 1993, Orth and Moore 1993). *Thalassia testudinum* is characteristic of stable low stress conditions (Neckles 1994). A decrease in *Thalassia* abundance and an increase in density of other seagrass species in areas previously dominated by *Thalassia* is usually indicative of declining environmental conditions (Neckles, 1994) or reflects the influence of some type of disturbance (Williams, 1990).

Powell *et al.* (1989, 1991) and Fourqurean *et al.* (1995) observed a change from *Thalassia* to *Halodule wrightii* after 8 yr of nutrient enrichment from birds utilizing specially designed perches in eastern Florida Bay. This species change is consistent with the view that *Halodule* is a pioneering species which is more common in disturbed sites. Disturbances to seagrass beds such as blowouts, dredging and prop scarring may increase the susceptibility of the beds to additional losses because of sediment displacement, the removal of the root and rhizome mat, and the reduction in short-shoot cover. Seagrasses are important in trapping and stabilizing sediments by baffling currents and forming a complex root and rhizome mat (Ginsburg and Lowenstam, 1958; Fonseca and Fisher, 1986). With the loss of unconsolidated

sediments, the recovery of these ecosystems will be slow (Zieman 1982) and it is characterized by an increase in species diversity during intermediate successional stages (Patriquin, 1975). Decreases in abundance of *Thalassia* and increases in species diversity have occurred in Florida Bay in areas that have experienced both die-off (Robblee *et al.* 1991) and light reduction (Phlips *et al.* 1995, Stumpf *et al.* 1999). The increase in *Halodule* and the recruitment of *Halophila* in western Florida Bay reflects a change to a lower-light adapted seagrass community.

The number of species in a seagrass bed is dependent on a number of factors. However, under long-term stable conditions, one species is usually dominant in any given area (Dawes *et al.*, 1985; Iverson and Bittaker, 1986; Williams, 1990; Short *et al.*, 1990). Changes in species diversity or community structure are indicative of some fundamental change in ecological conditions. Tilman (1982, 1988) suggests that, following a disturbance, plant community structure will be determined by species' abilities to compete for limiting resources. Within the coastal seagrass communities in the southeastern U.S., this competition most frequently leads to monotypic *Thalassia testudinum* under stable, low nutrient, high salinity and light conditions. As shown in the examples above, seagrass beds exhibiting an increase in species diversity may indicate a departure from stability, and they may reflect a perturbed or stressed state. This suggests that departures from low diversity seagrass beds are frequently not a good sign.

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COASTAL PHYTOPLANKTON BLOOMS: WHAT ARE THEY TELLING US?

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ABSTRACT

Coastal eutrophication has been well documented for most areas of the world, including the Southeastern U.S.. Phytoplankton blooms, a significant ecological consequence of coastal eutrophication, have been hypothesized to result from causes as diverse as anthropogenic inputs of limiting nutrients to the disruption of normal biological controls. The implication of the title for this paper is that human activities are responsible for the disruption of these controls and consequently are responsible for coastal phytoplankton blooms. Smayda (1997), however, asks "What is a bloom", and argues that if that question can be answered then the cause-effect relationships should be discernable. If a bloom is defined as "a population of cells of a given species above background levels," such widely varying factors as the anthropogenic flux of limiting nutrients, the role of physical concentration of phytoplankton populations, and the potential disruption of a primary trophic level (seagrass declines) with subsequent nutrient release, can all be regarded as causative factors that have led to elevated levels of phytoplankton biomass in coastal waters. Summaries of four blooms that occur along the east and Gulf coast of the U.S., *Pfiesteria piscicida*, brown tides, a cyanobacteria bloom in Florida Bay, and *Gymnodinium breve* red tides on the West Florida Shelf, are provided to illustrate the role of anthropogenic nutrients and other factors in bloom initiation and maintenance. Of the four blooms, only the *Pfiesteria piscicida* bloom can be directly linked to cultural eutrophication. Elevated nutrient concentration is detrimental to brown tide populations, no source of nutrients can be found to support the Florida Bay cyanobacterial bloom, and West Florida Shelf red tides originate in oligotrophic shelf waters. Therefore the answer to the question poised in the title of this paper must be: A mixed message - but a message which should not be ignored.

INTRODUCTION

It is now generally accepted that nuisance or harmful phytoplankton blooms have been increasing in frequency and extent over the last decade (Hallegraeff, 1993; Paerl, 1988; Paerl, 1997; Smayda, 1990). Human populations in the coastal zone are growing at a rate three times higher than the rate for the total U.S. population (Culliton *et al.*, 1989). Coincident with these population increases are changes in land-use patterns within coastal watersheds that lead to alterations in the timing and volume of fresh water inflows and related anthropogenic nutrient loadings to estuarine and coastal waters. The effect on algal communities is elevated biomass and production of both microalgae and macroalgae. Such changes at the primary producer level are responsible for widespread losses of benthic macrophytes as a result of reduced light availability to the benthos (Boynton *et al.*, 1996), extensive hypoxia events in the coastal waters off Louisiana (Rabalais *et al.*, 1996), loss of benthic herbivore populations during brown-tide events (Tracey, 1988; Bricelj and Lonsdale, 1997), and in some areas, blooms of toxic species that result in the death of organisms at higher trophic levels. A major long term consequence of these coastal blooms is the potential for a shift in food web dynamics in the ecosystem and the subsequent disruption of economic benefits from use of the coastal zone.

How do we define a "Bloom"?

Some clarification of the term "bloom" is required before proceeding. The descriptor was typically used to describe the annual increase in phytoplankton abundance that occurred in temperate and boreal waters during spring or early summer, i.e. the 'spring bloom' (Smayda, 1997; Sournia, 1995). Some confusion has arisen because terms such as 'red-tides', 'nuisance algal blooms' (Paerl, 1988), and 'harmful algal blooms' (ECOHAB, 1995) are used interchangeably to describe apparent sudden and dramatic increases in phytoplankton biomass which may or may not discolor the water. Smayda (1997) argues that the use of such descriptors as 'unusual', 'nuisance', and 'harmful' as modifiers of the term 'bloom' are subjective and add to the confusion concerning the definition of a bloom. Paerl (1988) also argues that the use of the term 'bloom' is highly subjective. For the purposes of discussion in this report I will use the term 'bloom' as a catch-all for the above terms; i.e. a 'bloom' will refer to any increase in the abundance or the biomass of phytoplankton above normal background concentrations that are found during non-bloom periods (Vargo *et al.*, 1987; Steidinger *et al.*, 1998) irrespective of whether the organisms involved are beneficial, nuisance or harmful species.

The definition is of more than just academic interest because all blooms must be put into a biogeochemical context. Typically in the 'spring bloom' context, the term refers to a large increment, an order of magnitude or larger, in phytoplankton abundance or biomass. Such large increases are indicative of changes within the ecosystem; either as a result of increased "new" (*sensu* Dugdale and Goering, 1967) nutrient input that has elevated the carrying capacity of the environment, a change in biotic controls on population levels such as grazing, or a change in abiotic parameters that controlled dispersion such as residence time or mixing. Unfortunately, the term "bloom" has also been used to refer to rather small increments in population abundance such as in the *Dinophysis* spp. "blooms" in France (Smayda, 1997) where a doubling of population abundance is viewed as a bloom. Using the term 'bloom' for such minor population increases clearly can occur without major changes in nutrient input, breakdown of biotic controls, or shifts in physical control mechanisms. Therefore, the context of how the term "bloom" is used is important because it carries an implication that a series of physical, chemical, and biotic controlling factors have been operative or have been negated.

Additional concerns related to the increased extent and frequency of blooms in coastal waters include harmful short-term effects such as toxicity to humans or wildlife, hypoxia and anoxia, and loss of fisheries and recreational use of coastal waters. Such pressures on estuarine and coastal environments will only increase in the future.

Since it is not possible to evaluate all cases within the southeastern U.S. coastal waters, I will attempt to summarize the factors involved with the formation and maintenance of several of the more publicized blooms that have occurred along the Atlantic seaboard and Gulf coast. Several groups of phytoplankton, both non-toxic and toxic species, are responsible for most of our recent coastal phytoplankton blooms. Attempting to understand the interaction of factors that are responsible for

the inception and growth of such a diverse group of organisms is a major challenge in the field of phytoplankton physiological ecology.

Stages of a bloom

Generally a bloom can be divided into four stages: initiation, growth, maintenance, and dissipation (Steidinger and Vargo, 1988). Each stage can be characterized by a variety of physical, chemical, and biotic interactions. The major factors are summarized below and are listed in Table 1. Naturally each bloom event is the result of a succession of some subset of these criteria. A classic scenario of bloom formation starts with nutrient inputs from deep mixing or upwelling events followed by stratification of the water column under suitable light, temperature and salinity regimes for growth to occur in excess of losses. Elevated nutrient inputs alone may not yield increased biomass particularly if the flushing rate of the receiving water body is high (Monbet, 1992). Thus in order to answer the question posed in the title of this paper, coastal phytoplankton blooms must be evaluated on a case by case basis.

Table 1: Factors associated with water column blooms

Physical

- Vertical and horizontal water column stability
- Residence time of a water parcel
- Vertical turbulence and shear
- Current transport
- Convection cells
- Fronts

Chemical

- Inorganic and organic sources of major nutrients (Nitrogen, Phosphorus, Silicate)
- Ratios of major nutrients
- Availability of minor (trace) nutrients as co-factors

Biotic

- Reduced grazing by macrozooplankton and microzooplankton
 - Reduced grazing by benthic filter and suspension feeders
 - Motility
 - Phototaxis/Migratory behavior
 - Allelopathy
 - Allelochemical effects
 - Toxin production
-

FACTORS THAT CONTROL WATER COLUMN BLOOMS

Physical

Vertical and horizontal water column stability have long been known as key factors involved with the inception and growth of dinoflagellate and cyanobacteria blooms in fresh waters (Reynolds and Walsby, 1975; Paerl, 1988) and marine waters (Margalef *et al.*, 1979; Smayda, 1970). Vertical turbulence and shear at boundaries may act as a selection mechanism as well as a suspension mechanism. In many instances diatoms require a turbulent environment to remain suspended in the water column and enhance growth (Thomas and Gibson, 1990) whereas recent studies indicate that shear stress and turbulence cause physical damage, physiological impairment, and behavioral modification (e.g. migratory patterns) in dinoflagellates (see Smayda, 1997 for a review).

Physical processes such as current transport, convection cells, and fronts are also concentration mechanisms for phytoplankton in general (see Franks, 1992) and dinoflagellates in particular (Margalef *et al.*, 1979; Steidinger and Haddad, 1981; Tyler and Seliger, 1978). Margalef *et al.* (1979) highlighted the importance of dinoflagellate motility in relation to increasing physical stability of the water column along frontal zones for the maintenance of red tides.

Chemical

Adequate supplies of the primary inorganic and organic nutrients, nitrogen and phosphorus, are required for the initiation, growth, and maintenance of coastal phytoplankton blooms. Up to the point of light limitation, the concentration of nutrients available will determine the maximum biomass or "yield". Sources for nutrients include natural and anthropogenic point and non-point sources, internal recycling, direct and indirect wet and dry atmospheric deposition, ground water, nitrogen fixation, and advective processes such as tidal exchange and gravity circulation.

Evidence is increasing to support the hypothesis that the ratio of nutrients entering the ecosystem is a key selection mechanism for particular groups of phytoplankton (Smayda, 1990; Sommer, 1989). The availability of nitrogen relative to phosphorus and silicate (Si) will favor the growth of flagellates versus diatoms or nitrogen fixing cyanobacteria (Hecky and Kilham, 1988; Paerl, 1988, 1997; Smayda, 1990; Sommer, 1989 among others). Blooms of the toxic diatom *Pseudo-nitzschia* spp. in the northern Gulf of Mexico have been associated with peaks in the discharge of the Mississippi River (Dortch *et al.*, 1997). Nitrogen and phosphorus loadings in the Mississippi River have increased over this century and have accelerated since 1950 while silicate levels have either remained the same or have decreased due to reduced freshwater inflow to the river (Rabalais *et al.*, 1996). Enhanced biomass of *Pseudo-nitzschia* appears to result from the increased nitrogen loading from the Mississippi relative to silicate lowering the Si/N ratio which gives this species a competitive advantage (Sommer, 1994).

Organic sources of nitrogen and phosphorus are also important since many flagellated bloom species are mixotrophic and may be stimulated by organic inputs. The relationships between *Pfiesteria piscicida* Steidinger & Burkholder and organic

inputs has been well documented. Smayda (1997) provides a concise summary of the multiple nutritional modes that may give bloom forming species, both nuisance and harmful, a competitive advantage.

There is now evidence of links between several essential trace metals such as iron and molybdenum with nitrogen-fixation, excretion of the fixed "new" DON, and subsequent blooms of dinoflagellates (see Paerl, 1988) . Indeed, several freshwater cyanobacterial blooms (Paerl, 1988 and 1997) and West Florida Shelf *Gymnodinium breve* Davis red tides have been linked with iron availability (Martin and Martin, 1973; Walsh, person. comm.).

Biotic

Biologically mediated mechanisms that can lead to blooms include reduced grazing stress, phototaxis and vertical migration, and allelopathic or allelochemical effects on co-occurring species. Reduced grazing pressure by water column macrozooplankton or microzooplankton has been accepted as the main reason for the inception of the winter-spring phytoplankton bloom in most temperate and boreal waters (Martin, 1965; Sommer, 1989). Conversely, increases in the populations of benthic filter and suspension feeders can lead to dramatic reductions in water column phytoplankton populations (Officer *et al.*, 1982; Doering and Oviatt, 1986).

Allelopathy and the production of allelochemical products that stimulate or inhibit another species is perhaps the most controversial phase of biological interactions that affect the competitive ability of phytoplankton species. Smayda (1997b) describes five types of allelochemical relationships that may act to provide an advantage to a species: mutually advantageous interactions; mutually exclusive interactions; selective inhibition; selective stimulation; and indifference. The net result of any one of these interactions is to influence growth rates, affect yields (i.e. carrying capacity) or induce cell lysis. Therefore, if active in blooms, production of bioactive compounds may be important as selection mechanisms for particular species.

SUMMARIES OF REPRESENTATIVE COASTAL BLOOMS

A partial summary of noteworthy phytoplankton blooms that have occurred along the eastern seaboard and the Gulf of Mexico is given in Table 2. This listing alone strongly suggests that intense phytoplankton blooms of both non-toxic and toxic species commonly occur in estuarine and coastal waters. Species such as *Pfiesteria* and its relatives, which were not discovered until the 1990's, are being found in other areas (see Fig. 1) at an alarming rate (Landesburg *et al.*, 1995; Steidinger *et al.*, 1995). Brown tides, unknown until the 1980's, can now be found from Texas to Rhode Island (Fig. 2) (Bricelj and Lonsdale, 1997; Smayda and Villareal, 1989; Buskey, 1996). Reports of *Gymnodinium breve* red tides were historically confined to the Gulf of Mexico until the 1970's when blooms were found along the east coast of Florida. Discovery of a major *G. breve* bloom in North and South Carolina waters in 1987 greatly extended the range for blooms of this neurotoxic species. Reports

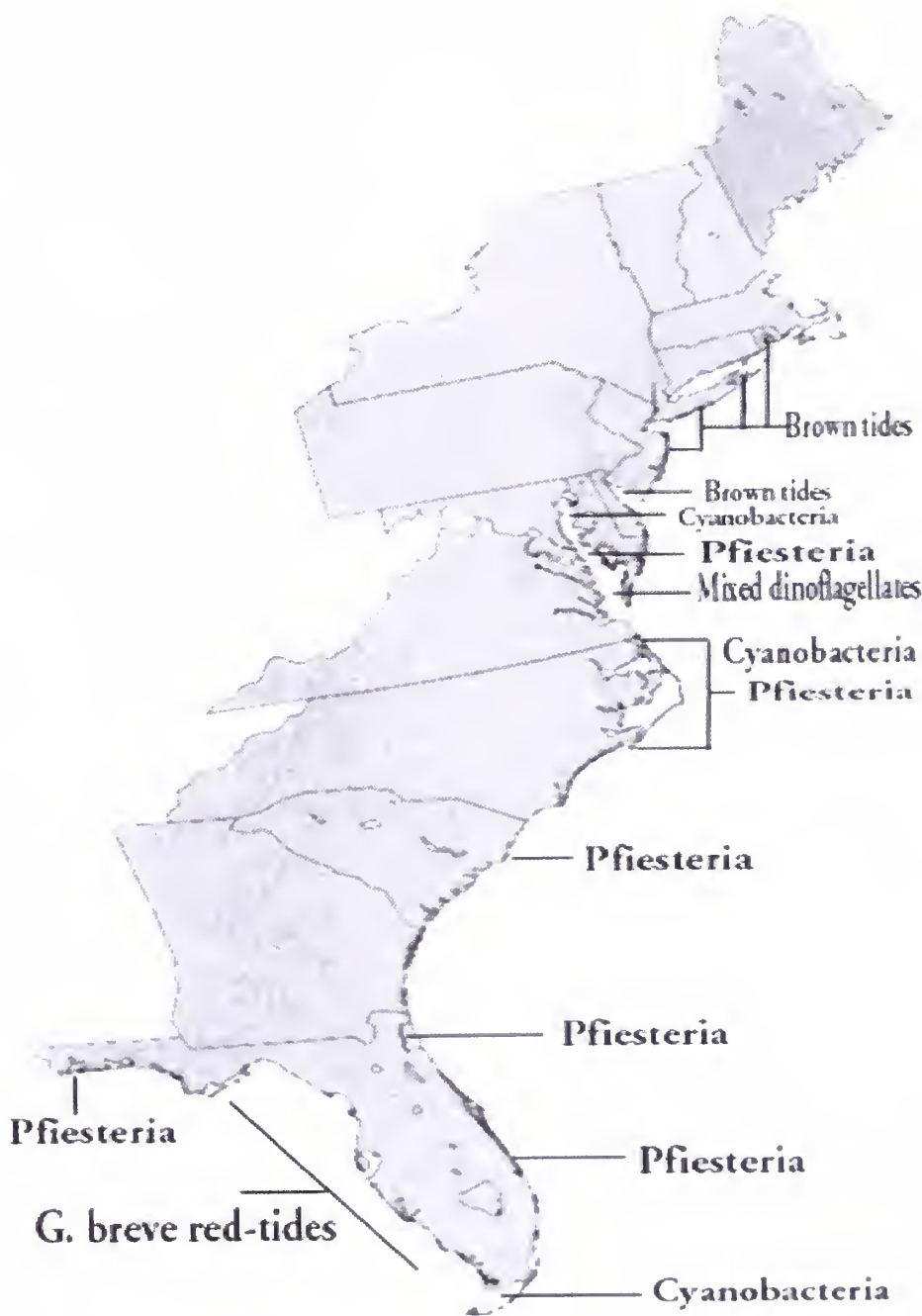


Figure 1. Approximate locations and types of phytoplankton blooms reported along the mid-Atlantic, east, southeast and Gulf of Mexico coasts. Modified and adapted from ECOHAB (1995).

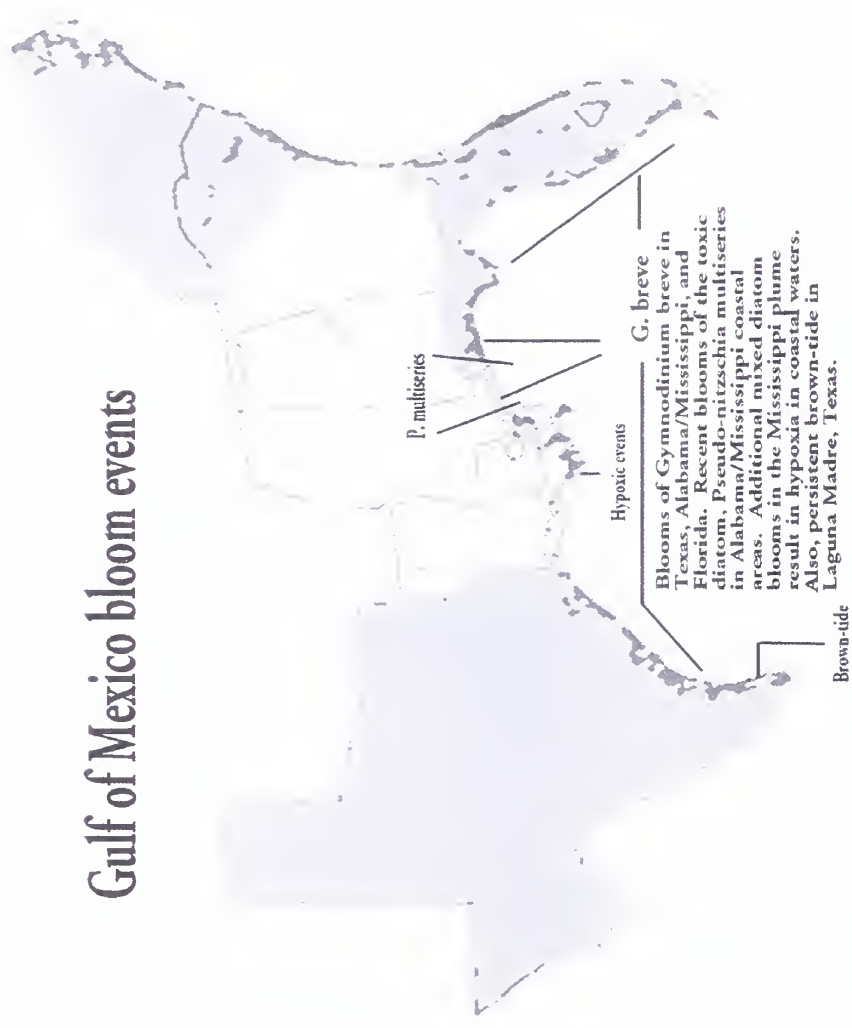


Figure 2. Approximate locations and types of phytoplankton blooms reported for coastal regions in the Gulf of Mexico. Modified and adapted from ECOHAB (1995).

of *G. breve* red tides in Mississippi and Alabama low salinity coastal waters, suggests that even this widespread species (Tester *et al.*, 1993; Geesey and Tester, 1993) which is rarely found below a salinity of 24 psu (Steidinger *et al.*, 1998) has a few surprises left for us to ponder.

As indicated previously, it would be impossible to include a summary of all of the blooms listed in Table 2. In order to illustrate the difficulty in obtaining an answer to the question poised in the title of this manuscript, a synopsis of our knowledge of the factors leading to *Pfiesteria* blooms, brown tides (and a related cyanobacterial bloom in Florida Bay), and the *Gymnodinium breve* red tides will be presented.

Table 2: A partial summary of phytoplankton blooms reported in the East, Southeast and Gulf of Mexico regions.

Species	Location	Toxicity	Reference
<i>Pfiesteria piscicida</i> and related species	Inland Bays, Del Chesapeake Bay Albermarle-Pamlico New River , NC Neuse River, NC Cape Fear Est., NC South Carolina St. John's River, FL Indian River, FL Florida Bay, FL Pensacola Bay, FL Mobile Bay, AL	toxic	Burkholder and Glasgow Jr. 1997
Brown tides <i>Aureococcus</i> <i>anophagefferens</i>	Narragansett Bay, RI Peconic Bay, LI, NY Great South Bay, LI, NY Barnegat Bay, NJ	nontoxic	Smayda & Villareal 1989 Bricelj & Lonsdale 1997 Casper <i>et al.</i> , 1989
<i>Aureomonas</i> <i>lagunensis</i>	Delaware Bay, DL Laguna Madre, TX	nontoxic	Buskey, 1996
Cyanobacteria <i>Anacystis</i> sp.	Potomac River, VA		Sellner <i>et al.</i> , 1993
<i>Microcystis aeruginosa</i>	Neuse River, NC		Pinckney <i>et al.</i> , 1997
<i>Synechococcus</i> <i>elongatus</i>	Florida Bay, FL		

Table 2 (continued)

Species	Location	Toxicity	Reference
Dinoflagellates			
<i>Gymnodinium breve</i>	West Florida Shelf	toxic	Steidinger & Joyce, 1973
	Texas Coastal waters		Buskey, 1996
	Mexican waters	Tester &	Steidinger, 1997
	Mississippi		
	Alabama		
	Florida East Coast		
	North & South Carolina		
Diatom			
<i>Pseudo-nitzschia spp.</i>	North. Gulf of Mexico	toxic	Dortch <i>et al.</i> , 1997
	Galveston Bay, TX		
Raphidophytes			
<i>Heterosigma akashiwo</i>	N.Y. Bight, N.J	toxic	Smayda, 1998
	S. Car. coastal waters		
	Florida Bay		
	Tampa Bay		
Other dinoflagellates			
<i>Gymnodinium pulchellus</i>	Indian River, FL	toxic	Steidinger <i>et al.</i> 1998b
<i>Gymnodinium galatheanum</i>	Texas,	toxic	Nielsen, 1993
	S. Carolina, MD		
<i>Alexandrium monilata</i>	St. Lucie River, FL	toxic	Steidinger <i>et al.</i> , 1998
	Indian River, FL		
	St. John's River, FL		
<i>Ceratium furca</i>	Chesapeake Bay	nontoxic	Marshall, 1995
<i>Cochlodinium heterolabatum</i>	"	nontoxic	
<i>Gyrodinium aureolum</i>	"	toxic	
<i>Gymnodinium nelsoni</i>	"	nontoxic	
<i>Prorocentrum minimum</i>	"	?	
<i>Noctiluca scintillans</i>	"	nontoxic	

Pfiesteria piscicida and *Pfiesteria*-like blooms

Pfiesteria piscicida Steidinger & Burkholder is one of several ambush type predatory dinoflagellates that occur in Atlantic and Gulf Coast estuaries (Burkholder *et al.*, 1998). Two other related species with similar life history strategies but of unknown toxicity are now known to occur in north and east Florida estuaries and have been referred to as *Pfiesteria*-like species (PLS). Severe fish-lesion events have also been associated with PLS in several area including the St. Lucie River although the evidence is circumstantial at this point in time (Steidinger, pers. comm.). All of these dinoflagellates have highly complex life cycles that incorporate amoeboid stages, flagellated zoospores, and cysts (Burkholder and Glasgow, Jr., 1997). Prey items range from bacteria to fish with some life history stages acquiring chloroplasts

from autotrophic cells (kleptochloroplastidy) and using them to provide additional carbon via photosynthesis (Burkholder *et al.*, 1998). *P. piscicida* is known to have at least 22 stages in its life history and all are predatory in one form or another.

Why do we care about these organisms? Essentially all stages of *P. piscicida* have the ability to produce highly effective ichthyotoxins when fish are present in the water column (Burkholder *et al.*, 1998). Blooms of this species are responsible for the loss of millions of fish in at least six North Carolina estuaries with one event lasting approximately 90 days and over 15 million dead fish (Burkholder and Glasgow, Jr., 1997). Intoxication of human laboratory workers has been documented (Glasgow, Jr *et al.*, 1995) and anecdotal evidence of field intoxications of fisherman has also been recorded. Signs of toxicity include short-term memory loss, respiratory distress, and epidermal lesions that do not respond to antibiotic treatments (Burkholder and Glasgow, Jr., 1997). Therefore, the factors that stimulate growth and contribute to the maintenance of blooms of these species are of critical concern.

Blooms of *P. piscicida* are difficult to classify as 'typical'. Although populations of the flagellated stage are enhanced within a parcel of water, elevated populations are related to the presence or absence of fish within the water column. *P. piscicida*, or rather its cysts residing in the sediments, appears to have a unique chemosensory ability which allows it to identify and track schools of fish via a yet unidentified compound released by fish. The first response to the presence of fish is excystment and production of motile zoospores followed by the generation of toxin. The zoospores then attach to the fish, begin to digest it and introduce toxins which then kill the fish. After the dead fish sinks to the bottom the zoospores produce amoeboid stages which complete digestion of the fish. Gametes can be produced by zoospores which can produce large amoeba stages that also produce cysts to start the cycle again. This entire process can occur in the space of hours to a few days. Thus a 'bloom' of *P. piscicida* occurs in response to the presence of an organic compound, perhaps analogous to a nutrient injection, and has a duration of days rather than weeks or months.

P. piscicida is a typical estuarine organism with a wide range of temperature and salinity tolerance (Burkholder *et al.*, 1998). Since the species is heterotrophic and phagotrophic, light is not of concern except when the cells have photosynthetic potential from kleptochloroplastidy (Steidinger *et al.*, 1995). Toxicity is retained across a wide light gradient from total darkness to 250 $\mu\text{E}/\text{m}^2/\text{sec}$ (Burkholder *et al.*, 1995).

An aspect of the ecology of this species that is of critical concern is the relationship between population abundance and anthropogenic nutrient loadings. Field studies of the species distribution have found significant correlations between elevated populations of *P. piscicida* and PLS and chronically enriched areas (Burkholder and Glasgow, Jr, 1997). Approximately 75% of toxic *Pfiesteria* outbreaks were associated with nutrient enriched waters (Burkholder *et al.*, 1995). Statistically significant correlations have also been calculated for the abundance of *P. piscicida* with wastewater treatment facilities. This association may be an indirect effect, as noted above, in that N and P loadings may stimulate the growth of

autotrophic microalgae which then serve as a food source for *Pfiesteria* (Burkholder and Glasgow, Jr., 1997).

The evidence presented in several articles by Burkholder and others makes a reasonable case that *P. piscicida* and other PLS are characteristically found in nutrient enriched areas and that associations with both point and non-point sources of anthropogenic enrichments occur frequently. The conclusion based on what is known to date must be that blooms of this toxic species are related to cultural eutrophication and enrichment of our coastal zone.

Brown tides: Aureococcus anophagefferens and Aureoumbra lagunensis .

Blooms of these small, pelagophyte picoplanktors have occurred over a wide area of the eastern U.S. seaboard (*A. anophagefferens* Hargraves *et al.* Sieburth) and the S.W. Gulf of Mexico in the Laguna Madre (*A. lagunensis*) (Fig. 2). The first bloom of *A. anophagefferens* occurred in Narragansett Bay, RI in 1985 followed by blooms in several Long Island Bays (Bricelj and Lonsdale, 1997). Over the next several years it was reported from several embayments in Connecticut, coastal lagoons in New Jersey, and in confined areas of Delaware Bay. The distribution of *A. anophagefferens* is depicted in Figure 3. Blooms have occurred in Long Island bays every year from the first bloom in 1985 through 1995. They typically last from May through September with highest cell densities in June or July (Bricelj and Lonsdale, 1997). The brown tide has not recurred in Rhode Island waters although the cells are present at low population levels (Keller and Rice, 1989; Nixon *et al.*, 1994).

A. lagunensis is slightly larger than its northern counterpart (4-5 μ m diameter) but has a similar morphological and anatomical structure and pigment complement. However, it does not test positive for the polyclonal antibodies developed for *A. anophagefferens* and has several other differing characteristics that warrant it being put into a separate genus (DeYoe and Suttle, 1995). Examination of preserved samples indicate that the Laguna Madre bloom started in 1990 in Baffin Bay, a small embayment off northern Laguna Madre. In contrast to the Long Island blooms which have a distinct seasonality, the Laguna Madre bloom persisted into 1997 (Buskey *et al.*, 1997) but started to dissipate in 1998 (Villareal, pers. comm., 1998). Although *A. lagunensis* did spread from its initiation zone in Baffin Bay throughout the Laguna Madre system, it has not been found in other coastal lagoons to the east with the exception of a positive test for its presence in Florida Bay based on use of a monoclonal antibody (Villareal, pers. comm., 1998).

Although no toxicity has been demonstrated for either brown tide species, the blooms do have an adverse impact on their respective ecosystems. High populations of *A. anophagefferens* reduced light availability for benthic macrophytes leading to reduced sea grass populations (Dennison *et al.*, 1989). Populations of the mussel (*Mytilus edulis*) and bay scallops (*Argopecten irradians*) were adversely affected in Narragansett Bay (Tracey, 1988) and Long Island bays (Wenczel, 1987) resulting in large economic losses for the shellfish industry in both areas. Effects of reduced grazing by ciliates, macrozooplankton, and other bivalves have also been documented (Tracey, 1988; see Bricelj and Lonsdale, 1997).

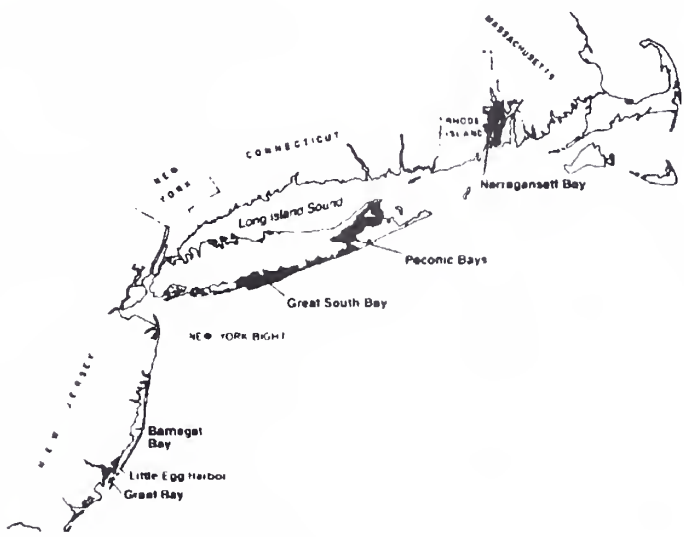
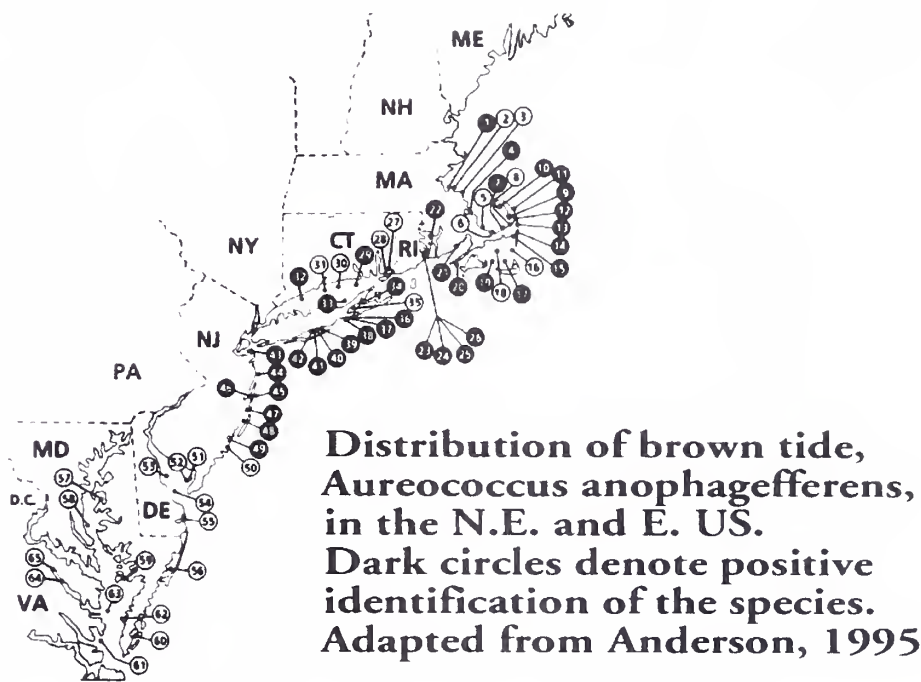


Figure 3.

Buskey and Stockwell (1993) showed that both microzooplankton and macrozooplankton grazing rates were reduced by the Texas brown tide with a disruption of the normal food web in Laguna Madre. Major losses of the sea grass, *Thalassia testudinum* also occurred in Laguna Madre as a result of light attenuation by high biomass of the brown tide. Since the sea grass beds served as habitat and cover for many of the commercially important fin fish populations the region also experienced an economic loss directly related to the bloom.

Brown tide bloom dynamics

Blooms of both species have several characteristics in common. They both occur in shallow, unstratified and well mixed, bays with long residence times (Vieira and Chant, 1993; Buskey, 1996). Reduced flushing in Long Island embayments was attributed to reduced wind stress and low subtidal sea level oscillations (Vieira, 1989) whereas reduced rainfall and high evaporation rates contributed to residence times of >1 year in Baffin Bay, Texas. Bloom initiation occurred at a time of hypersalinity in both locations. Although many areas of Laguna Madre are normally hypersaline, salinities increased to ~60 psu as a result of the drought. Similarly, anomalous winter and spring droughts characterized the Long Island blooms in 1985 and 1995 with elevated salinity in the shallow embayments (Bricelj and Lonsdale, 1997; Buskey, 1996). High salinity *per se* is not required for the growth of both species. Blooms have occurred over salinity ranges of 22 - 35 psu with a maximum growth rate for *A. anophagefferens* at 28 psu. Growth - salinity data for *A. lagunensis* is not available but unpublished laboratory studies demonstrate that best growth occurs at higher salinities (~40 psu as opposed to 20 to 30 psu, Buskey, unpublished). Conversely, a bloom of *A. lagunensis* started in Copano Bay, TX in the summer of 1991 at a salinity of <5 psu which suggests that it has a wide salinity tolerance.

Elevated nutrient levels were not associated with the inception of the Long Island brown tide blooms. Rather, the population density of *A. anophagefferens* is inversely related to nutrient enrichments. Nutrient enrichment studies in large mesocosms were ongoing at the time of the Narragansett Bay bloom and clearly demonstrated that populations in N, P, and Si enriched mesocosms were an order of magnitude less than in control mesocosms (Keller and Rice, 1989). In fact, *A. anophagefferens* is capable of growing and maintaining numerical dominance at inorganic nitrogen concentrations which are limiting to other species, including diatoms (Keller and Rice, 1989). A similar study in shallow, lagoonal mesocosms in 1994 also found that population abundance was lower in enriched mesocosms (Nixon *et al.*, 1994).

In Laguna Madre, the initiation of the brown tide was coincident with elevated ammonia levels that may have been related to a massive redfish die-off as a result of a hard freeze (Buskey, 1996). Since *A. lagunensis* can take up but not assimilate nitrate because it lacks the enzyme nitrate reductase, the availability of ammonia may have been a key factor for initiation of the bloom. However, the bloom persisted for more than 7 years over long periods of low, <2 μ M ammonia levels without major changes in biomass.

Chelators and trace or minor elements may, however, play a key role in the maintenance and growth of *A. anophagefferens* populations (Cosper *et al.*, 1993;

Gobler and Cosper, 1996). Laboratory studies have shown that additions of iron and selenium stimulated the growth of this species (Cosper *et al.*, 1993). Iron concentrations in Long Island bays are higher than surrounding waters. This has led to the speculation that increased use of iron rich ground water as a source of irrigation, which increased runoff into the bay, may have provided the nutrient climate necessary for inception of the bloom in these areas.

If one views increases in macronutrients as an indication of cultural eutrophication then the available evidence for the inception and maintenance of both *A. anophagefferens* and *A. lagunensis* blooms suggests that neither brown tide was the result of increased loading of macronutrients.

Cyanobacterial blooms with particular reference to Florida Bay

Cyanobacterial blooms have been commonly found in lakes, ponds, streams and the freshwater tributaries of estuaries or bays (Paerl, 1988). Descriptions of the dynamics of these blooms are replete in the literature and will not be covered here. Of the cyanobacterial blooms listed in Table 2, anthropogenic inputs of excess nutrients have been linked to the Potomac River and Neuse river blooms (Sellner *et al.*, 1988, 1993; Paerl, 1988). Typically cyanobacterial blooms develop after an increase in nutrient loading via runoff during spring rains is followed by increasing temperatures, water column stability and reduced rainfall and drought conditions that reduce river flow and increase residence time. Such factors appeared to control the cyanobacterial blooms in the upper Potomac and Neuse Rivers (Sellner, 1988; Mallin, 1994) and the Nueces River and Nueces Bay in Texas (Roelke *et al.*, 1997).

The cyanobacterial bloom that occurred in Florida Bay and persisted for over 6 years differed from 'typical' freshwater blooms in several ways and may have similarities with the brown tides that have occurred in the northeast US and Laguna Madre.

Florida Bay is a large (~2200 km²), shallow (avg. depth of ~1m) estuary, interspersed by mudbanks that may be exposed at low tide thus forming a series of interconnected basin (Fig. 4). It is a partially enclosed embayment bounded on the north by Everglades National Park and on the northeast, east, and south by the Florida Keys and Highway 1. Its western boundary is open to the Gulf of Mexico and is a major point for exchange of water and nutrients.

Historically, Florida Bay was characterized as a sea grass dominated ecosystem with macroalgae and a crystal clear water column. Sea grasses provided habitat for pink shrimp, many species of molluscs, and juvenile game fish while hard bottom areas were populated by sponges, hard and soft corals and other filter and suspension feeders. The sponges and macroalgae, in turn, also served as nursery areas and habitat for juvenile Florida lobster (*Panulirus argus*).

During the summer of 1987 sea grasses, primarily turtle grass (*Thalassia testudinum*) began to die. The die-off continues in parts of the bay to today although there is now re-growth occurring in many areas of the Bay (Durako, 1998). At its peak over 40,000 ha or approximately 18% of the total area of the Bay was affected although different studies have made slightly different estimates of the area affected (Zieman *et al.*, 1988; Roblee *et al.*, 1991; Thayer, 1994). It is of interest that the first signs of sea grass die off occurred in the northern and western areas of the Bay, e.g.

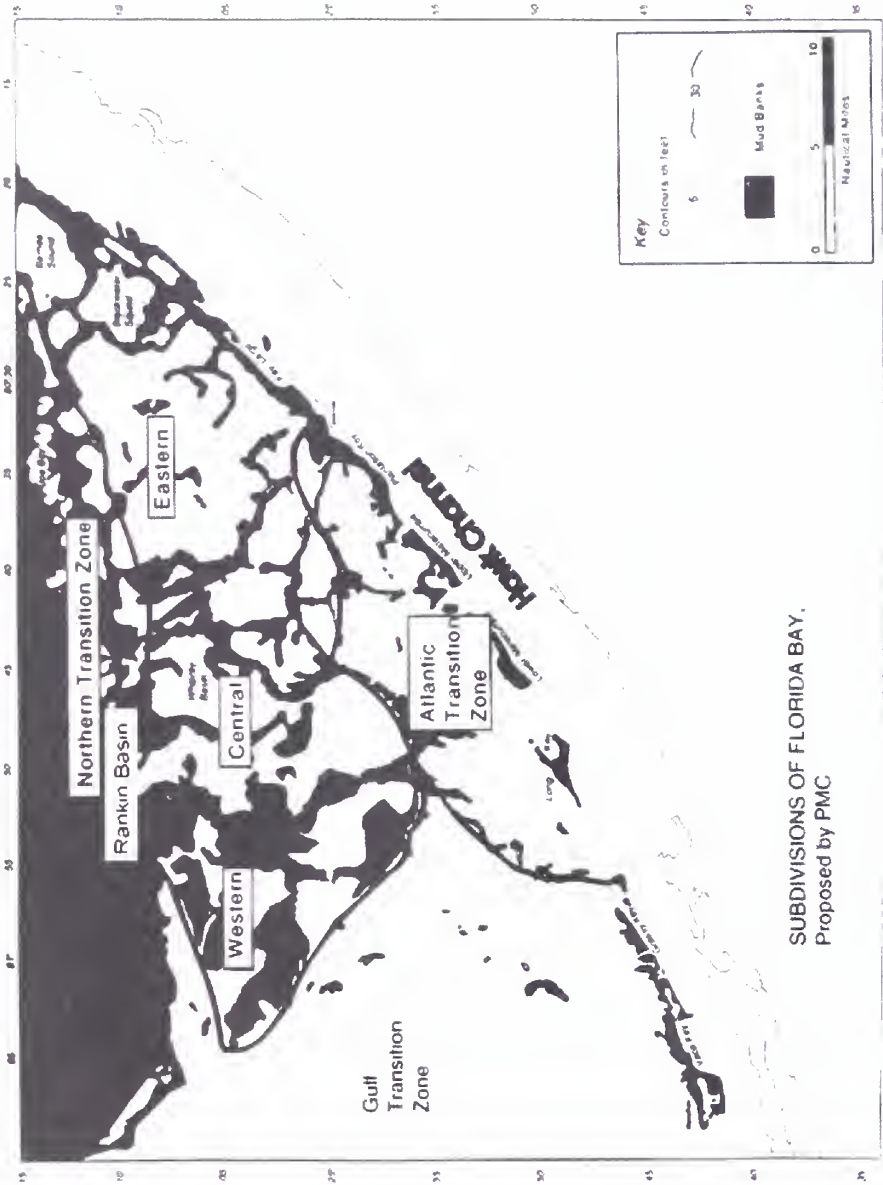


Figure 4. A generalized map of Florida Bay depicting the proposed subdivisions of the bay, the locations of mudbanks, the main passes for flow through the Florida Keys and the location of Hawk Channel. Adapted and modified from the FBPMC.

Rankin, Johnson and Rabbit Key basins. These areas experienced higher salinities than basins to the south and east.

Approximately four years after the sea grass die off a massive algal bloom started in Northern Florida Bay in the region of Rankin Basin (Fig. 4). *Synechococcus elongatus* has been identified as the causative organism. This small (approx. $1 \times 2 \mu\text{m}$) species first appeared in 1991 at population densities of $> 10^8$ cells per liter. Blooms have typically started in the north central basins of Florida Bay and extended southward into the area now designated as the proposed Atlantic transition region (FBPMC, 1997; Fig. 4). Indeed, the 1992-1993 and 1994-1995 blooms extended from Rankin Basin on the north, through the passes of the middle Keys into Hawk channel (Fig. 4). The 1992-1993 bloom covered $>1000 \text{ km}^2$ with cell densities $>10^9$ cells per liter and chlorophyll concentrations of $>20 \mu\text{g/l}$.

Coincidental and/or concomitant with the cyanobacterial blooms, populations of molluscs, sponges and tunicates, juvenile fish, pink shrimp and water birds were adversely affected. Populations of several species of bivalves declined dramatically during the 1994-1995 bloom (Lyons, 1996), a massive sponge die-off occurred with subsequent declines in spiny lobster catches (Butler *et al.*, 1995). Major declines in the catch of pink shrimp (Browder, 1996) have also been documented although the latter effect appeared to have started prior to the sea grass die-off of 1987. Loss of benthic filter and suspension feeders may also have prolonged water column blooms due to reduced grazing rates (Vargo *et al.*, 1996).

A variety of hypotheses have been offered in explanation of the sea grass die-off and the cyanobacterial bloom - some connect the two events as cause and effect with an ultimate cause due to reduced freshwater inflows to the Bay while others point to increased anthropogenic sources of nutrient input from northern rivers and bays and the development of the Keys along the northeastern and southern boundaries. Thayer *et al.* (1994) reiterate an earlier summary of the current hypotheses that suggest the most probable reasons for the sea grass declines center on the weakening of *Thalassia testudinum* by high population abundance (i.e. at carrying capacity) and environmental stress (hypersaline conditions for extended periods) making it vulnerable to disease. The finding of large scale infections of the slime mold, *Labyrinthula* sp., in areas of the die-off adds to the credibility of this general hypothesis. Regions such as Rankin Basin which experienced medium to high salinity changes and a continuing sea grass die off were associated with increased prevalence of *Labyrinthula* whereas basins which had widely fluctuating salinities with pulses of low salinity had a low prevalence of *Labyrinthula*, few lesions, and minimal sea grass die off.

While this may be a plausible scenario for the demise of sea grass populations, other explanations are needed for the initiation, growth and maintenance of the cyanobacterial blooms. Since the sea grass die off started in or near Rankin Basin and the seasonal cyanobacterial bloom also starts in the same area annually (C. Tomas, pers. comm.), a cause-effect relationship was immediately hypothesized. Nutrients, released from sea grass degradation and released from the sediments due to loss of plant cover and increased resuspension, were now available for *S. elongatus*. Additional sea grass die off as a result of reduced light availability from high cyanobacterial populations and the loss of benthic infauna and filter and suspension feeders provided additional nutrients and reduced grazing pressure which allowed the blooms to persist.

Nutrient concentrations within Florida Bay, the coastal waters of the Keys, and the West Florida Shelf are all characteristically low. Inorganic nitrogen and phosphorus levels are near detection limits along the western boundary and offshore, although concentrations in nearshore waters are elevated (Lapointe and Clark, 1992). The standing stock of nutrients in Florida Bay (Fourqurean *et al.*, 1993; Boyer *et al.*, 1997) would not appear to be sufficient to maintain the high biomass of *S. elongatus* found during the bloom. Moreover, the type of limiting nutrient varies within the Florida Bay complex: Phosphorus limitation is consistent in

eastern Florida Bay, an alternation between phosphorus and nitrogen limitation occurs in the central basins, while nitrogen and silicate may alternately limit growth in western Florida Bay (Tomas, 1996). Consequently, the sources of nutrients that are required to support this bloom has been a major area of discussion.

Lapointe and Clark, 1992 and Lapointe and Matzie (1996) have suggested that anthropogenic inputs of nitrogen and phosphorus from the Keys via ground water intrusion and runoff, flux of phosphate from the rivers and bays along the central West Florida coast and organic nitrogen flux from the Shark River are an important source of nutrients for the cyanobacterial blooms in central Florida Bay and the diatom blooms along the western boundary of the Bay. Recent use of a viral probe by Paul *et al.*, 1997 to trace water input from sewage systems through the porous carbonate bed rock has clearly demonstrated a connection between septic tanks on the Keys and nearby coastal waters. In addition, flow measurements in a series of wells on both sides of the Keys and in Florida Bay, examination of the nutrient content of ground water, the differences in hydraulic head between Florida Bay and Hawk Channel, and the use of gas tracers confirm that ground water may act as a source of nutrients for coastal waters on both sides of the Keys but these studies cannot confirm long distance N-S transport of materials into or out of Florida Bay (Shinn *et al.*, 1996).

At this point in time, the source of nutrients required to support the cyanobacterial blooms in Florida Bay is as yet unknown. Currently the Bay-wide blooms are in decline. They do occur annually but are now confined to the upper central basins of Florida Bay (C. Tomas, B. Bendis, pers. comm.). We can now begin to ask - What has changed? Sea grass populations are also returning (Durako *et al.*, 1998), perhaps in response to increased water clarity. Are nutrients again being tied-up in sea grass biomass? The lack of answers to these and other questions allows us to use the tried and true phrase: "Much more work needs to be done".

Brown tides and the Florida Bay bloom

There are several areas of similarity between the brown tide blooms in the northeast U.S., in Texas and the cyanobacterial bloom in Florida Bay. The initiation of both types of blooms appears to be related to an increase in salinity and the input of organic material. Reduced flushing rates, either through low rainfall or freshwater flows is also a common characteristic. Both types of blooms also do not appear to be related to anthropogenic nutrient inputs. While one can argue that this has not been determined for Florida Bay blooms, the fact that no major sources for either N or P can be identified suggests that recycled nutrients played a key role. However, no explanation has been given for the seasonal nature of the blooms.

There are also similarities in the effects of the brown tides and cyanobacterial blooms; primarily in their impact on benthic filter and suspension feeders, e.g. bivalves. Die offs occurred in Narragansett Bay, Long Island embayments and in Florida Bay. Since a toxin has not been identified for either bloom species, the effect may be related to their small cell size and extremely high abundance.

The similarities between the brown tides and cyanobacterial bloom may only be coincidental but they do raise questions about species selection and competition. Do hypersaline conditions select for these picoplankton sized organisms? Are increased organic loadings the main factor? Since one of the concerns for the future is finding enough potable drinking water to support coastal populations increased withdrawals from rivers, streams, and ground water will certainly produce higher salinity in nearshore and coastal waters. A current trend toward the use of desalination plants will also impact the salinity of coastal waters. Therefore, the possibility exists for an increase in "brown-tides" and cyanobacterial blooms since there is a potential relationship between the inception of these blooms and hypersaline

waters. The ultimate consequence would be a total alteration of estuarine food webs and utilizable productivity.

Gymnodinium breve blooms in the Gulf of Mexico

Blooms of the toxic dinoflagellate, *Gymnodinium breve*, in the Gulf of Mexico were reported by the early Spanish explorers when they arrived in this area region of the world. Remarks in the journal of Alvar Nuñez Cabeza de Vaca, written in 1530 when he landed in the Tampa Bay region, accurately describe fish kills and discolored water. Later, in 1542 he also described stories by local Indians of similar circumstances (Steidinger *et al.*, 1998). In 1844 the first newspaper account of a massive fish kills and noxious "gases" along west coast beaches were published (Feinstein, 1956). Therefore *G. breve* blooms in the Gulf of Mexico have been ongoing long before the more recent development and habitation of the Florida Peninsula.

G. breve blooms are not strictly confined to the West Florida Shelf although this is the region where they occur most frequently (Steidinger *et al.*, 1998). Elevated populations that cause water discoloration (2×10^6 c/l), fish kills ($1\text{--}2.5 \times 10^5$ c/l), NSP intoxication ($>5 \times 10^3$ c/l), or respiratory irritation (2×10^3 c/l) have been recorded from Mexico, Texas, Louisiana, Mississippi, Alabama, Florida, South Carolina, and North Carolina (Steidinger *et al.*, 1998). While *G. breve* is present at low population levels in the Gulf of Mexico, the Gulf Stream and the South Atlantic Bight throughout the year (Geesey and Tester, 1993; Tester *et al.*, 1993), the most infamous case of transport out of the Gulf occurred in 1987 when a bloom of *G. breve* caused millions of dollars of economic loss in North and South Carolina (Tester *et al.*, 1991). Typically, however, the region of greatest impact has been the area along the West Florida Shelf from Tarpons Springs to Ft. Myers/Sanibel (Fig. 2) where blooms have occurred in 21 or the past 22 years (Steidinger *et al.*, 1998).

Blooms can occur in any month of the year but are most frequent in late summer/fall (Tester and Steidinger, 1997) and typically originate 18–74 km offshore (Tester and Steidinger, 1997) in oligotrophic waters (Steidinger *et al.*, 1998) potentially associated with fronts related to the meanders of the Loop Current (Steidinger, 1975; Steidinger and Haddad, 1981). Populations display a migration response that may be phototactic or negative geotaxis (Heil, 1986) and results in the accumulation of high cell numbers at the surface during daylight hours. Onshore transport may then be the result of wind driven surface flows or relationships with fronts (Tester and Steidinger, 1997; Haddad and Carder, 1979; Haddad, 1982).

G. breve has all of the attributes of a K-selected species. Low levels of inorganic nitrogen and phosphorus support maximum uptake and growth (Vargo and Howard-Shamblott, 1990; Steidinger *et al.*, 1998), and it can use organic phosphorus (Wilson, 1966; Vargo and Shanley, 1985; Vargo and Howard-Shamblott, 1990) and nitrogen (Wilson, 1966; Shimizu and Wrensford, 1993; Shimizu *et al.*, 1995; Steidinger *et al.*, 1998). Primary production rates of shelf populations do not appear to be nutrient limited since rates are higher than background and blooms persist for long periods (Vargo *et al.*, 1987). Mid-shelf phosphate stocks will support a population of $\sim 10^6$ cells at normal growth rates ($\sim 0.2/\text{day}$) however higher stocks of nitrogen are required ($\sim 3 \mu\text{M}$ for 10^6 cells) which are not present in mid-shelf waters. Uptake rates for ammonia and nitrate are low suggesting the species is highly efficient at acquiring inorganic nitrogen at the low levels found along the oligotrophic shelf. Overall, *G. breve* appears to be adapted for growth in low nutrient regions. Bloom inception therefore, is not related to anthropogenic nutrient input.

Questions arise, however, about the maintenance of these blooms when they do reach the coast. Surface populations during daylight hours may attain $>10^7$ cells/liter. High populations can persist for weeks and months in nearshore waters or when entrained in bays and lagoons that have poor flushing rates. The source of nutrients required to sustain

populations under these circumstances have not been determined. Flux of phosphorus from Tampa Bay or Charlotte Harbor, two phosphorus enriched estuaries on the West Florida coast, is only sufficient to maintain a population of 10^5 cells/l at a growth rate of 0.2/day (Vargo, 1988; Steidinger *et al.*, 1998). Other sources of nutrients are necessary but have not been identified. Anthropogenic inputs of nitrogen from sources other than coastal bays and rivers is necessary because rivers and bays in central Florida are nitrogen limited due to the high phosphate enrichment from the Hawthorne phosphate deposits in this region (Vargo and Shanley, 1985). Atmospheric wet and dry deposition of nitrogen compounds has not been investigated but this is an important source in other coastal waters (Paerl, 1997). Therefore, we cannot conclude at this point in time that nutrients of anthropogenic origin are responsible for the initiation, growth, or maintenance of *G. breve* red tides on the West Florida Shelf.

COASTAL PHYTOPLANKTON BLOOMS: WHAT ARE THEY TELLING US?

At this point in the history of blooms in coastal U.S. waters the answer to the question must be "a mixed message". There is sufficient evidence to state that certain types of cyanobacterial blooms and blooms of *Pfiesteria* and PLS are related to anthropogenic inputs and hence cultural eutrophication. Although they have not been discussed in this summary, the *Pseudo-nitzschia* blooms and mixed phytoplankton blooms within the area of influence of the Mississippi River discharge (Dortch *et al.*, 1997; Rabalais *et al.*, 1996, respectively) are also clearly related to enhanced nutrient loadings and changes in the ratio of major nutrients. Smayda (1990) and Hallegraeff (1993) have given detailed summaries of world wide HAB and coastal blooms and their relationship with nutrient loading of coastal waters. Clearly, however, there are blooms which may not be directly related to elevated nutrient inputs (e.g. the brown tides, Florida Bay cyanobacterial bloom, and possibly Gulf of Mexico red tides). At this point in time we still have not been able to deduce the reasons for the inception of these blooms but we cannot dismiss man's alteration of the surrounding ecosystem as a causative factor. Human induced alterations of local watersheds may yield unexpected changes in downstream estuaries and coastal waters (Valiela *et al.*, 1992).

Perhaps the message being given to us by these disturbances in our coastal waters is simply a belated wake-up call which should not be ignored.

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BIOLOGICAL IMPACT OF THE GULF STREAM ON COASTAL MARINE ECOSYSTEM

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ABSTRACT

The coastal marine communities of the southeastern United States from Florida to North Carolina are profoundly influenced by the finger-like protrusion, meanders and eddies from the western wall of the Gulf Stream and associated episodic upwellings, which result in increased productivity and recruitment in the continental shelf, Blake Plateau and the slope. This paper examines conceptually the biological influences of the Gulf Stream core rings which occur mostly north of the Cape Hatteras, with some preliminary data of recent climatological pulses that are probably induced by global warming. The following aspects will be discussed: (1) formation of the fingers off the coast of Carolinas north of the Charleston Bump (2) benthic Fish with focus on recruitment processes in the temperate reefs off Carolinas, (3) fish, lobster and turtle migration in the Gulf Stream, and (4) bird abundance in the Gulf Stream fronts.

INTRODUCTION

The purpose of this paper is to summarize the biological impact of the Gulf Stream on coastal ecosystems. It is known from satellite imagery that the Gulf Stream exhibits seasonal variations and is influenced by the Charleston Bump which deflects the Gulf Stream with significant biological consequences (Brooks and Bane, 1978; Pietrafesa, 1978). The easterly deflection of the Gulf Stream at the Charleston bump is eventually turned back by the North Atlantic Gyre and helps to form the Charleston Trough. The trough exhibits a seasonal cyclonic rotation and episodic upwellings which in turn promote a large amount of biological activity via the following sequence of events : increase in nutrients, phytoplankton, zooplankton and higher level trophic organisms such as fishes, turtles and oceanic birds associated with the frontal zones.

The Gulf Stream was originally described by Benjamin Franklin and Timothy Folger in the 1770 chart that enabled ship captains to avoid this swift current and to speed the passage to New York. This powerful current occurs closer to the coast off Florida than to the other states and moves away from the coast as it moves toward the North Carolina coast because of the topographic configuration of the continental shelf and the Blake Plateau. This boundary current has prevailed for about 65 million years but its course and boundaries have changed since the beginning of the Cenozoic period. Paleocene strata are deeply eroded in the sub-surface of the Florida-Hatteras slope and this may mark the initial appearance of the Gulf Stream. Millions of years of erosion and sea level changes brought the Gulf Stream to the path it travels today, roughly 200 km off Charleston. Traveling at a high speed the Gulf Stream reaches the Charleston Bump, located at 32 N latitude and 79 W

longitude where the deflection takes the Stream eastward about 60 to 110 km from the 200 m isobath.

This deflection is subsequently bent back in a northwesterly direction and eventually the Stream begins to swing toward the North Carolina coast. The Charleston Trough is formed (Fig. 1) on the western side of the Gulf Stream Front and the water within the trough rotates cyclonically (counter-clockwise). However, there is seasonal variation in the flow of the Gulf Stream along the coast of Carolinas. Starting in November the current changes direction due to winds and adjacent currents. Therefore, the southerly moving currents are contributing to the cyclonic motion. This pattern of flow changes in January to April, flowing in an easterly direction. The cyclonic flow fades during the spring months. There is also a high concentration of chlorophyll in the Spring. The upwelling effect of the Charleston trough provides a primary area for the life cycle of several of maine life.

Gulf Stream Rings

A "ring" is any large eddy formed from a meander of the Gulf Stream, both from its eastern and western wall. A warm or cold core "Ring" in the ocean is a flow structure associated with an isolated mass of anomalous water, significantly warmer or colder, saltier or fresher than its surroundings (Csanady, 1979). Gulf stream rings are the most energetic form of mid-ocean mesoscale eddies and are responsible for a significant part of the recirculation of the gulf stream via their formation, movement and ultimate coalescence with the Stream. Warm core rings and cold core rings begin as meanders in the Gulf Stream which interact with existing rings or they can protrude like a finger and then loop and eventually detach to form a ring. The meanders usually form after the Gulf Stream turns east from the North American continent at Cape Hatteras. It is from these meanders that warm and cold core rings originate.

The Gulf Stream is a high velocity stream that separates the cold water (54 to 68 Fahrenheit) on its left side from the warm waters of the Sargasso sea on its right. The water depth of the Gulf Stream is still poorly defined but the ripple marks of photographs taken as deep as 900 meters off the coast of Carolinas confirms that the Gulf Stream impact on the bottom extends not only to the Blake Plateau around 600 meters but as also on the upper continental slope. George (unpublished data) found that the deep sea hermit crab *Parapagurus pilosimanus* exhibits its maximum abundance where the the Gulf Stream comes into contact with the the under-lying Western Boundary Under Current (WBUC). Their abundance is also associated with area where episodic upwellings occur between the Gulf Stream fingers and the western wall of the Gulf Stream (Fig.2). The maximum abundance of 240 crabs per one hour bottom trawl time in the summer is at a depth of 620 meters. During upwelling periods both in early summer (June) and mid-fall (October) the temperature between 600 and 750 meters reaches as low as 7° to 8° C which seems to be the optimum temperature conducive for the initiation of gametogenesis. Gravid females were only found between 600 and 700 meters although the adult crabs are caught from as shallow as 350 meters and as deep as 4500 meters. The data also suggest that the spawning occurs between November and February at

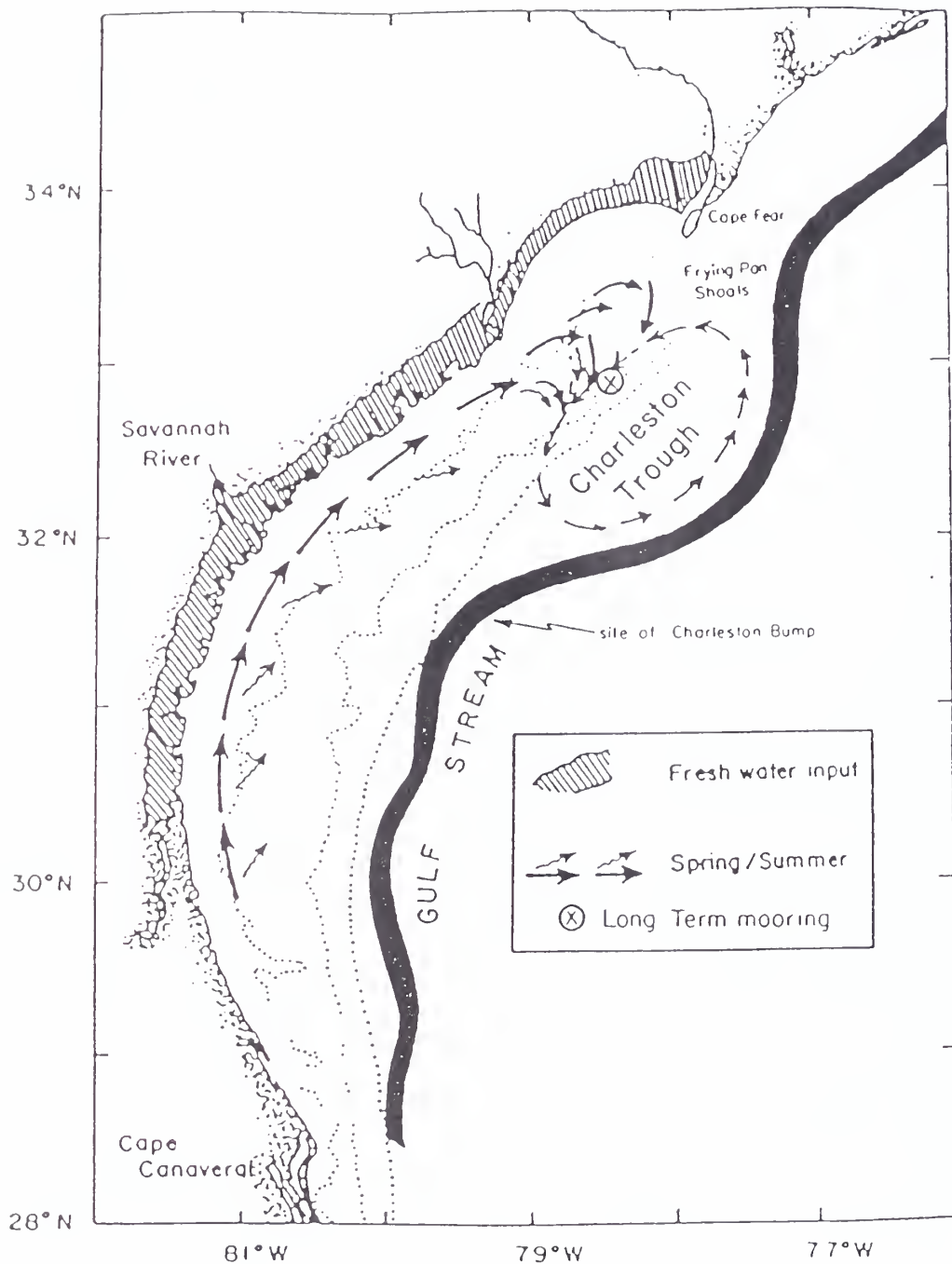


Fig. 1. The course of the Gulf Stream off Georgia and Carolinas (dark line) and the easterly deflection at the Charleston Bump. Note the formation of the Charleston trough and the clock-wise circulation (From Pietrafesa, 1978)

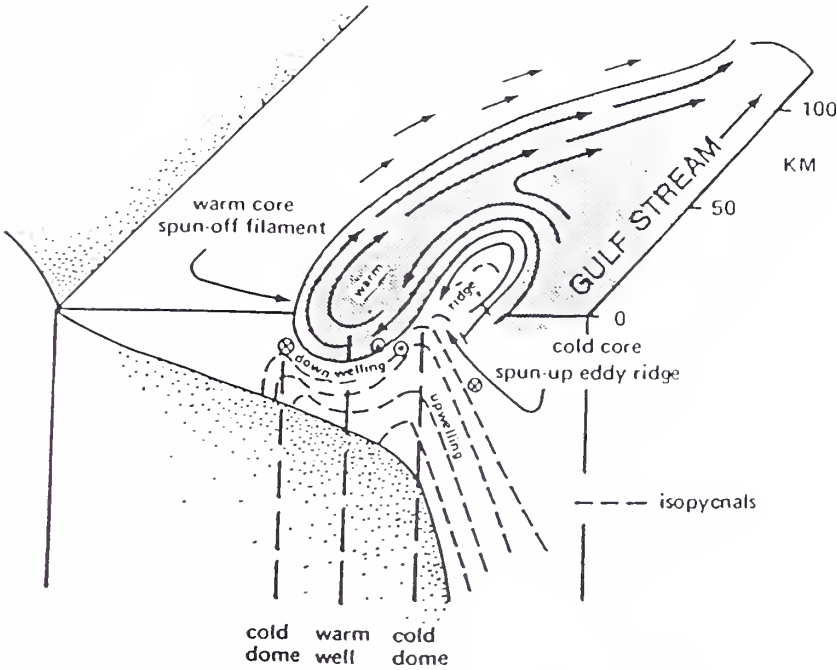


Fig. 2. Diagram showing the upwelling between the Gulf Stream finger and the western wall of the Gulf Stream (From Pietrafesa, 1983)

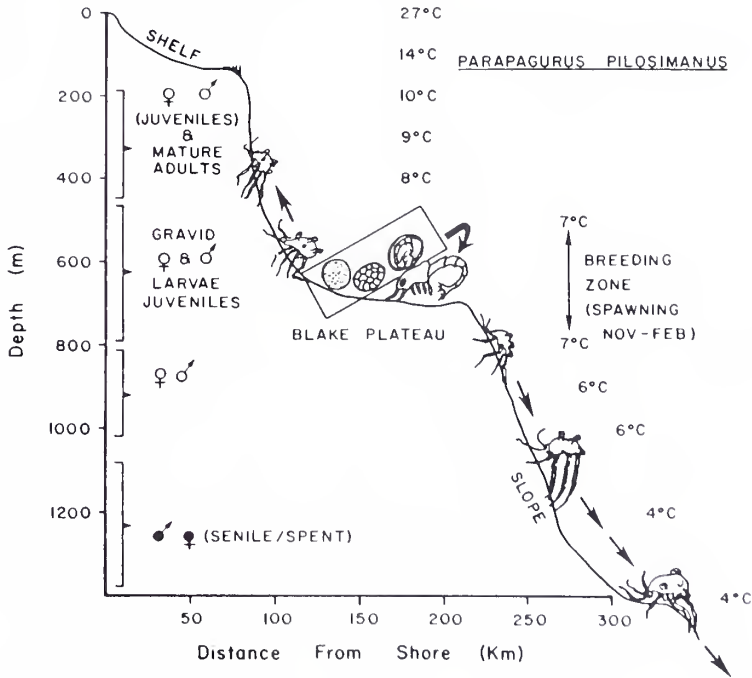


Fig. 3. A Schematic diagram showing the bottom profile and the distribution of the hermit crab *Parapagurus pilosimanus* with the identification of the breeding zone.

depths between 600 and 750 meters at around 7 C. (Fig. 3). Therefore, the upwelling cold water may induce favorable reproductive conditions. This hypothesis calls for more experimental data.

Cold core rings, formed south of the stream, have a central core of cold slope water surrounded by a ring of high velocity cyclic currents. Warm core rings, formed to the north of the stream, are an isolated lens of warm Sargasso Sea water lying on top of the colder slope water (Flieri, 1979). Off Cape Hatteras significant interactions occur between the rings and the Gulf Stream every 3 or 4 weeks. The rings also play a role in the transfer of biota and recruitment of benthic species over the continental shelf. Based on his studies in April 21 -25, 1980, Pietrafesa (1983) reported an upwelling event in the Gulf Stream frontal filaments that consisted of an anticyclonically rotating water mass with a cold dome underneath. He confirmed that upwelling occurs both in the cold dome region and below the warm tongue. George (unpublished data) observed a similar event of upwelling in a study in 1985 in the Charleston Bump area aboard the research vessel *Cape Hatteras*.

Rhoads and Hecker (1994) reported that south of Cape Hatteras the Gulf Stream meanders are found to be up to 700 meters deep and have velocities of 40 cm/s. They also found that water within the eddies carries particulate organic matter (POM) from the outer shelf environment. Although they found chlorophyll a concentration to be low in the Gulf Stream (below 0.1 mg/sq.m, the ring concentrations were much higher at 0.5 mg/sq.m. Hitchcock (1994) discovered that the core ring bacterial cell carbon biomass was higher (18 mgC/sq.m) in relation to shelf water (10 mgC./sq.m). The Gulf Stream meanders and eddies contribute significantly to the shelf carbon budget, as much as 11 % of the total particulate carbon (Walsh, 1993)

Recent studies, both in the Georges Bank and Swedish west coast over a period of six summers, pointed out that there appears to be significant year-to-year changes in the benthos of the Southern Georges bank and along the west coast of Sweden (George, unpublished data). There seems to be a 6-7 year cycle in the abundance and decline of the Arctic Krill *Meganyctiphanes norvegica* in the Gullmar Fjord in Sweden where bottom oxygen saturation went to hypoxic levels in certain years (1995 and 1996) because of significant delays in the winter renewal of bottom water. In 1997 the bottom water became anoxic and Thillart *et al* (1999) discovered that the arctic krill can not survive below 20 % oxygen saturation level. It is also known that the fisheries off the west coast of Sweden, including the shrimp *Pandalus borealis*, show a 6-7 year cycle in their abundance and decline. It may be possible that such a cycle is linked to the changes in the North Atlantic Oscillation (NOS) that is an offshoot of the Gulf Stream northeast of the Cape Hatteras. It is not clear whether this climatological change is induced by global warming. George (unpublished data) observed an increase in the abundance of bacteria-infested deep water brachyuran crab *Cancer borealis* in the southern George Bank from 1995 to 1999. It is also not clear whether climatological change is responsible for high incidence of infested crabs in Southern Georges Bank which is subjected to the influence of the Gulf Stream warm core rings.

Abundance and Recruitment of Fish through the Gulf Stream Eddies

Atkinson and Targett (1983) reported on the upwelling process along the 60-m isobath from cape Canaveral to Cape Hatteras and its relationship with fish distribution.

Acoustic measurements suggested that fish aggregations were associated with areas of upwelling. Surface salinity and alongside velocity observations also suggested an offshore flow of shelf water in the 32 to 33 N area. Between Cape Canaveral and Cape Hatteras the Gulf Stream meanders with periods of 1 to 2 weeks and wavelengths of 50 to 200 km. The upwelling seems to be more permanent in two areas. At 32 N a topographic rise causes a permanent meander in the Gulf Stream. Upwelling also occurs off Florida at 20 N although it is more seasonal. This study pointed out that the highest concentrations of fish were in the areas of pronounced upwellings off Cape Canaveral and off Southern South Carolina. However, fish concentrations were also associated with upwelling features off Cape Fear in North Carolina.. Fish concentrations are related to optimum thermal gradients and also reduced temperature in the boundary conditions at the front and by the enhanced primary productivity. In this zoogeographic zone commercially important benthic fishes such as the snappers and groupers are far more important than the pelagic fishes.

The upwelled water, always identified between the western wall of the Gulf Stream and the Gulf Stream filament or finger, has been proven to be rich in phytoplankton by earlier studies (Bishop *et al*, 1980; Yoder *et al*, 1981). This induces the attraction of numerous planktivorous fishes and in turn attracting piscivorous fishes to the upwelled zone at the edge of the Gulf Stream. Barans (1981) also pointed out that fishes are also attracted in response to the sharp thermal gradient for thermoregulation. He reported on large aggregations of red porgy (*Pagrus pagrus*), snappers (Lutjanidae) and groupers (Serranidae) at the thermal fronts, caused by the Gulf Stream intrusions off North Carolina coast. These benthic fishes are common in the continental shelf, mainly inhabiting the hard-bottom temperate reef areas.

It is not clear whether Gulf Stream eddies play any significant role in the recruitment of fish species in the temperate reefs off North Carolina coast. However, tropical reef fishes are commonly found in the waters off North Carolina (George and Staiger, 1979). Reef fishes in Onslow Bay can only survive in this region due to the influence of warm water intrusions from the Gulf Stream. Due to the fairly slow reproductive nature of these highly residential fishes, population dynamics are an important and complex issue for fisheries managers. The percentage of larvae transported from southern waters via the Gulf Stream remains unknown and until research is targeted at answering this question, possibly with the application of more sophisticated molecular tools to finger print DNA of different populations, a truly accurate understanding of stock populations of reef fishes in Onslow Bay will remain rather elusive.

Myer and Drinkwater (1989) came up the *a priori* hypothesis that the entrainment of shelf water by Gulf Stream warm core rings reduces recruitment of marine fish stocks through offshore transport. Their conclusion was based on weekly analysis of satellite images from 1973 to 1986. The data were combined with estimates of the timing of spawning and the duration of larval stages to create stock-specific annual

indices of ring activity and shelf-slope frontal variability. They concluded that increased warm core ring activity reduces recruitment in the 17 groundfish stocks.

Mesopelagic fishes, on the other hand, seem to respond to Gulf Stream fronts. Olson and Backus (1985) reported that net hauls in and around a Gulf-Stream warm-core ring in April and June contained significant concentrations of the mesopelagic fish *Benthosoma glaciale* (family Myctophidae) in the frontal zone at the east edge of the ring. Young fishes of age-0 class were five times as abundant at the frontal zone of the ring and two times as abundant in the center of the ring in comparison with population density of the fish in the adjacent slope water. Our knowledge of the depths of extension of the Gulf Stream are meager. Ripple marks, made by the Gulf Stream flowing north, give some clue that the impact of the stream may extend to depths as great as 900 meters. There are some indicator species such as the bat fish *Dibranchius atlanticus* living at the junction of the Gulf Stream and the Western Boundary Under Current (WBUC) at 900 meters (Markle and Musick, 1974). However, there is need for more careful investigations to document the influence of the Gulf Stream in the deep sea. Benthic photographs clearly reveal the junction between the Gulf Stream and the Western Boundary Under Current at depths varying from 800 to 1000 meters. There appears to be a seasonal signature but until more careful studies are made, this conclusion should be considered as very preliminary. The fundamental problem to document seasonal biological trends in the offshore waters under the impact of Gulf Stream is the lack of repetitive seasonal sampling of both plankton and benthos in the upwelling regions on a year to year basis.

Fish, Lobster and Turtle Migration through the Gulf Stream

The American eel *Anguilla rostrata* is known to have a life cycle that enables the early larval stages such as the *leptocephali* larvae to use the Gulf Stream eddies to move toward the shore across the continental shelf. As the larvae reach near shore, the metamorphosis of these larvae occurs and the new *elver* stage is attained. The elver larvae are introduced into the estuaries and rivers by tidal currents. When the eel matures and migrates in the fall season back to the sea to spawn, these mature eels pass through the Gulf Stream to reach the Sargasso Sea where these eels spawn. It is still a myth how the eels reach such a distant spawning ground. This problem still eludes scientists. It is not known whether the Gulf Stream eddies from its eastern wall plays any role in the migration of the eels.

Another classical example is the migration of the Blue fin tuna *Thunnus thynnus* which spawns in the Gulf Mexico and in the Caribbean. Females release 2 to 3 millions eggs every spring and summer (McGowan and Richards, 1989). Larval development is in the same breeding grounds. However, the juveniles and adults tend to move through the Loop Current into the Gulf Stream. The Loop Current from the Gulf of Mexico, originating from the Caribbean via the Yucatan Strait and continues northward into the Gulf of Mexico before exiting through the Florida Strait (Auer, 1987). The Gulf Stream carries these juvenile and adults to feeding grounds in the northern Atlantic Ocean. When these adults reach sexual maturity they migrate back to the tropics to reproduce (Nakamura, 1969). In the Gulf Stream juvenile and adult tuna feed on zooplankton, primarily copepods and euphausiids (Young and Davis, 1990).

The spiny lobster *Panulirus argus* also uses the Loop Current to enter the Gulf Stream. Phyllosoma larval stages are transported via the Loop Current into the Florida current and the Gulf Stream (Booth and Phillips, 1993; Herrenkind, 1994). The loggerhead sea turtle *Caretta caretta* is associated with the Gulf Stream in its migratory patterns. Important North American nesting sites of loggerhead turtles are at Cape Romain National Wildlife Refuge, South Carolina, Hutchinson Island, Florida, Jekyll Island and Little Cumberland Island, Georgia. Nest sites have been reported from Texas to New Jersey. Satellite tag studies suggested that loggerhead turtles do not wander randomly during intervals between nesting but will specifically go to stable substrate areas that contains adequate food supplies. These turtles are known to swim in a positive direction to feeding grounds. Loggerhead sea turtle rookeries occur along the east coast of the United States. The turtle hatchlings seem to be at the mercy of the currents such as the Gulf Stream and drift until they are strong enough to move of the Gulf Stream to adult feeding grounds.

Bird Abundance in the Gulf Stream Fronts

Studies of the Gulf Stream using remote sensing techniques have revealed that ring habitats affect seabird prey such as myctohid fishes and cephalopods. Olson and Backus (1985) reported on the concentration of organism at the fronts with particular reference to cold-water fish and a warm-core Gulf Stream ring. Haney (1986a) demonstrated seabird affinity for the Gulf Stream frontal eddies as a response to episodic upwellings. This study focused on spatial and seasonal patterns of apex consumers along Gulf Stream frontal areas off the southeastern United States continental shelf and slope on the basis of ship-board seabird counts and satellite hydrography. The results indicated that seabird densities at the eddies were 7-15X higher than in the resident shelf and the Gulf Stream waters, ranging from 2.31 to 10.91 birds per square kilometer compared to 15 to 1.51 per square kilometer in non-eddy regions. These authors concluded that " Eddies influence seabird distribution and abundance at spatial scales of 10 to 50 and 50 to 150 km and at time scales of 2 to 14 and 30 to 180 days. Seabird responses to environmental heterogeneity caused by eddies give circumstantial evidence for energy transfer beyond producers at these upwelling features."

Seabirds associated with the Gulf Stream eddies are the nekton-feeding *Puffinus lherminieri* and the storm petrels *Oceanites oceanicus* and *Oceanodroma leucorhoa*. Since seabirds are homeotherms (warm-blooded), such an adaptation increases their attraction to warm Gulf Stream eddies where availability of food is higher in the upwelled zones. Wilson's storm petrel *Oceanites oceanicus* is a trans-equatorial migrating seabird that breeds in the Antarctic. During the Antarctic winter it leaves the southern ocean and flocks to Atlantic Ocean. This bird is abundant at the Gulf Stream frontal zone (Haney, 1986b).

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COASTAL FISH DISTRIBUTION AND DIVERSITY IN THE SOUTHEASTERN UNITED STATES: HOW IS IT CHANGING?

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ABSTRACT

Fishes whose biology is closely tied to coastal ecosystems comprise the largest component of the fish fauna of the Southeastern United States. Coastal fish faunas are experiencing dramatic changes resulting from increases in human populations. Many coastal fish species are directly targeted for human consumption, either as food or animal products, or for recreation. Over-fishing is a serious problem for elasmobranchs and certain bony fishes with limited reproductive capacities. Many other species are impacted primarily through habitat loss or degradation resulting from a variety of causes, which include disruption through dredging, filling, and channelization, pollution from toxins, nutrients, and sediments, and introductions of non-indigenous species. Different taxa and geographic regions are differentially affected. Species with limited distributions, those associated with seagrasses, or those having anadromous life cycles are particularly at risk. Although limited data exist, estimates based on patterns of historical collecting strongly suggest that a significant fraction of coastal ichthyofaunal diversity will be lost to extinction and local extirpation in the next 50-100 years.

INTRODUCTION

Much of the fish fauna of the United States can be found within southeastern US and along its coastlines. Because this region encompasses numerous unevenly studied biotopes, it is difficult to determine and summarize changes in biodiversity. The task is complicated by an incomplete historical record and irregular seasonal change. Nonetheless, increasing human impact gives rise to concern for the preservation of this fauna and consequently, there is an urgency to discern and understand the implications of such change.

To assess changes in biodiversity requires a baseline that provides a measure of the natural occurrence and variation. Natural history collections are essential, since they form the only verifiable record for which identifications can be confirmed. Despite accumulation of more than 60 million fish specimens in North American collections, only 4% were collected before 1900 and 18% before 1950 (Poss and Collette, 1995). However, temporal and geographic precision are limited and sampling is biased. Although such records provide information about provenance, knowledge of fluctuations in population sizes is seldom available. Nonetheless, it is becoming clear that the fauna is changing primarily through influences of human origin. Changes may be categorized as extinctions, probable range changes, and populations declines and depletion. Introductions comprise the single greatest factor influencing biotic composition.

Extinction, Regional Extirpation, and Critical Endangerment

No coastal species in the region are as yet reported as extinct. However, the sea lamprey, *Petromyzon marinus* has vanished from the Gulf of Mexico and southern populations may also be approaching extinction, with recent records infrequent and based on southward migration of infected hosts (Gilbert and Snelson, 1992). Dam construction limiting suitable breeding sites, or higher water temperatures may have contributed to this decline.

As noted by Roberts and Hawkins (1999), *Syngnathus affinis*, the Texas pipefish, is another candidate for extinction. The species has been regarded as a subspecies of *S. fuscus* by some, but not by Dawson (1982), who provided the only detailed study and noted it locally abundant in 1976, but not seen since.

Pristis pectinata and *Pristis pristis* were major seasonal predators in the area prior to 1900, but sawfishes are now virtually extinct along the US coast (Bigelow and Schroeder, 1953; Caldwell, 1990; Compagno and Cook, 1995). These ovoviviparous species produce only 15-20 young per year and mature slowly (Adams and Wilson, 1996). It is unlikely that their numbers will greatly increase for decades, even under ideal conditions.

Range Contraction, Population Declines, and Stock Depletion

Overfishing, damming of rivers, habitat destruction, and water quality deterioration have combined to decimate both Atlantic and Gulf subspecies of *Acipenser oxyrinchus*. Recent recovery and management plans (Lukens *et al.*, 1995; Colligan *et al.*, 1998) document the decline of sturgeon that once supported fisheries. Adults mature from 7 to 21 years and do not reproduce every year. Many decades will be required for these plans to succeed. Recovery plans are complex, because maternal homing fidelity has resulted in geographic variation within both Atlantic and Gulf stocks (Bowen and Avise, 1990; Chapman *et al.*, 1993; Ong *et al.*, 1996; Smith *et al.*, 1996).

Destruction as commercial bycatch has caused the near extinction of *Raja laevis*, which once ventured as far south as South Carolina (Bigelow and Schroeder, 1953; Casey and Myers, 1998).

Pendleton (1995) documented dramatic declines and range restriction of *Alosa sapidissima*, a fate shared by *A. chrysochloris* and *A. alabamae* (Laurence and Yerger, 1967; Boschung, 1992). These result primarily from barriers to reproductive migration formed by dams and locks.

Factors Affecting the Decline of Native Species

Seagrass habitats in the Gulf of Mexico have declined dramatically from deterioration of water quality resulting from a variety of human activities (Neckles, 1993; Handley, 1995). With loss of habitat, pipefishes and seahorses also have declined. Because of sampling bias and rarity, it is difficult to assess the status of these species. Distributions of *Anarchopterus criniger*, *Microphis brachyurus lineatus*, *Hippocampus errectus*, *H. zosterae*, and may be increasingly patchy, especially in the northern Gulf. Although always more common in the eastern Gulf, may now be extirpated from Mississippi Sound. A 1990 record exists from the west end of North Island, Chandeleur Islands, but the area was scoured by Hurricane Georges. Reproduction in *M. b. lineatus* may be closely tied to freshwater, areas

exposed to housing development and herbicides (Dawson, 1982; Gilmore and Gilbert, 1992), but young occur well offshore among floating *Sargassum*. Males retain up to 750 brood pouch larvae, but often considerably fewer.

Bairdiella batabana is found in clear Florida waters over vegetated mud flats and in coral reef areas (Chao, 1978). This species may be at risk as *Thalassia*, *Cymodocea*, and *Diplanthera* beds are lost (Gilbert and Gilmore, 1992b). Similarly, *Gambusia rhizophorae* is closely associated with mangrove habitats that are under intensive pressure from human development, as well as periodic hurricane damage (Loftus and Kushlan, 1987; Gilbert, 1992).

Awous banana, *Gobiomorus dormitator*, *Gobionellus atripinnis*, *Gobionellus psuedofasciatus*, *Gobionellus stigmaturus*, and other gobiids, in the southwestern and southeastern Gulf of Mexico are imperilled because they are restricted to narrow reaches of coastal tributaries that have been greatly modified by industrialization, channelization, impoundment, and construction projects, as well as concomitant decreases in water quality (Gilmore, 1992a, 1992b; Gilmore and Yenger, 1992).

Enrichment from agricultural runoff poses a risk to *Agonostomus monticola* in the northern Gulf. Because adults are mostly confined to freshwater (Cruz, 1987; Loftus and Gilbert, 1992), the exact reproductive strategy of mountain mullet remains unclear. According to Dity and Shaw (1996), larvae may accumulate, if not originate, off the western Louisiana and Texas during summer months in a gyre that may supply scattered populations throughout the Gulf, even as far as Cuba, which Anderson (1957) attributed as source of Atlantic populations. This area is temporally and spatially near a large seasonal anoxic "dead zone" (Rabalais *et al.*, 1996).

Encroaching development in the Florida Keys may be adversely affecting *Menidia conchorum* (Gilmore, 1992c; Smith-Vaniz *et al.*, 1995). *Bairdiella sanctaeluciae* inhabits rock-reef habitats that support luxuriant growths of attached algae (Gilmore and Snelson, 1992), making it vulnerable to dredging and beach-renourishment.

Overfishing and stock depletion has lead to the loss of slow maturing species. Smith-Vaniz *et al.* (1995) summarized the declines in *Epinephelus itajara* and *E. striatus* that led to the closure of fisheries. Sharks, such as *Carcharinus obscurus* and *Carcharhinus plumbeus*, are slow to grow and mature, give birth to few young every other season, and thus vulnerable (Natanson and Kohler, 1996; Kohler *et al.*, 1997).

Introductions as source of new faunal elements

The southeastern US fish fauna is being altered by the introductions of non-indigenous species, a major force for change of ecosystems and their constituent faunas worldwide (Boydston *et al.*, 1995; Fuller *et al.*, 1999). Although this has led to an increase in the number of species, ecological and economic impacts are predominantly negative. Negative impacts on the native fish fauna result from direct predation and resource competition, as well as from indirect effects of habitat alteration.

Although there are as yet no instances of extirpation of native fishes over wide areas of the southeastern US, considerable evidence documents localized impacts of non-native species. *Lepomis macrochirus* has declined with introduction of the highly opportunistic *Cichla ocellaris* and *Cichlasoma cyanoguttatum* that compete for both food and nesting areas in coastal streams and ponds, as well as prey on the

young (Courtenay *et al.*, 1974; Shafland, 1996). Fury and Morello (1994) found another cichlid, *Astronotus ocellatus*, did not displace native fishes, but because minor competitive disadvantage may in time translate into total loss, the full effects of many introductions may not yet be evident.

Predation by non-indigenous species on native species of the region is well documented. Juvenile *Cyprinus carpio* feed on larval fishes and eggs when invertebrates are scarce (Lachner *et al.*, 1970). *Cichlasoma managuense* preys heavily on *Gambusia affinis* and other native species (Gestring and Shafland, 1997). With expanding range, this highly opportunistic feeder poses a threat to native-species, especially those occupying shorelines fringed by macrophytes. *Cichlasoma salvini* and *Clarias batrachus* are also predacious (Courtenay *et al.*, 1974). Courtenay and Miley (1975) reported walking catfish kill large bass, without consuming them. During periods of drought, individuals may congregate in isolated pools and consume most other species or hibernate in absence of food for up to 8 months. Highly opportunistic nocturnal feeding habits coupled with and its burrowing behavior make the swamp eel, *Monopterus albus*, a potentially severe threat to native species (Fuller *et al.*, 1999).

Hoplias malabaricus was extirpated by the cold winter of 1977, and no new introductions reported (Courtenay *et al.*, 1991; Shafland, 1996). It is primarily a diurnal piscivore, and young feed on crustaceans, algae, and aquatic insects (Hensley and Moody, 1975). First reported from ponds near Tampa Bay, it rapidly became the predominant species in terms of biomass and second in abundance. Because it remains a popular aquarium fish reintroductions pose special concern, especially as global temperatures rise.

Juvenile *Cichlasoma urophthalmus* serve as an important forage species for adults of predatory species, such as *Micropterus salmoides*, *Centropomus* spp., and *Megalops atlanticus*. But as this mangrove species grows, it eventually preys on the young of its predators, all important sport fish (Shafland, 1996).

Oreochromis aureus now dominant in many Gulf drainages competes aggressively with native fish for nesting areas and for trophic resources (Noble *et al.*, 1975). Diet overlap between juvenile blue tilapia and *Dorosoma* spp. has led to declines of shad in Florida (Zale and Gregory, 1990) and Texas (Hubbs *et al.*, 1978). This species forms 20-93% of the total fish biomass in numerous localities (Buntz and Manooch, 1968; Shafland, 1996).

Because *Oreochromis mossambicus* feeds on many foods, it competes with many native taxa. In the estuarine waters of Florida, it lowers biodiversity by competition for food and by direct predation. In Texas it imperils native faunas of stenothermal springs (Hubbs *et al.*, 1978). *Cichlasoma nigrofasciatum*, *Oreochromis mossambicus*, and *Tilapia zilli* exhibit similar behaviors and effects (Lorenz and Taylor, 1992; Mackereth and Keenleyside, 1993).

Species that disturb sediments, such as *Geophagus surinamensis*, *Carassius auratus*, *Ctenopharyngodon idella*, *Cyprinus carpio*, *Hypophthalmichthys molitrix*, and *H. nobilis*, render habitats unsuitable for native species and alter plant communities (Lachner *et al.*, 1970; Metzger and Shafland, 1984; Robison and Buchanan, 1988; Matlock, 1990; Richardson *et al.*, 1995). Other introduced herbivores, such as *Sarotherodon melanotheron* and *Tilapia zilli*, now constitute a threat to native aquatic plants (Courtenay *et al.*, 1984).

Prediction of dispersal and impacts resulting from introductions remains difficult. Although many introductions lead to increases in the size of the area invaded, others remained restricted. *Cichlasoma meeki* is both euryhaline and able to tolerate temperatures as low as 10.3°C (Shafland and Pestrak, 1982). However, its range has remained limited. Likewise, *Tilapia zilli*, first reported and now well-established in spring waters within San Antonio, have not spread appreciably (Howells and Garrett, 1992). This may result in part from complex biotic interactions. *Ctenopharyngodon idella*, *H. molitrix*, and *H. nobilis*, all imported for weed control, shift dietary preferences in unexpected ways, the latter two species being able to change to feeding on zooplankton when phytoplankton is scarce, variously affecting the abundance of native species (Charyev, 1984; Herodek *et al.*, 1989; Betolli *et al.*, 1990; Courtenay *et al.*, 1991; Maceina *et al.*, 1992).

Factors Affecting the Dispersal of Introduced Species

Because fishes introduced into the southeastern U.S. are mostly of tropical or semi-tropical freshwater origin, cold-temperature intolerance has limited their impact on the native coastal fauna (Courtenay and Stauffer, 1990; Courtenay *et al.*, 1991; Jennings, 1991; Shafland, 1996). Nonetheless, some, such as *Oreochromis aureus* and *Cichlasoma cynaoguttatum* have become widespread, the former in Florida (Shafland and Pestrak, 1982), the latter rapidly becoming dominant in highly altered New Orleans canals (Cashner and Humphries, pers. comm.). With its milder winters, southern Florida is more susceptible to the cumulative effects of introductions. Global warming will likely increase both the size of this winter refugium and the number of species in it.

Some introduced cold-tolerant species, such as *Cyprinus auratus*, *Cyprinus carpio*, *Ctenopharyngodon idella* pose a broadly distributed threat (Shafland, 1996). The common carp may hybridize with other cyprinids, adding "genetic pollution" as a concern (Taylor and Mahon, 1977). Others, such as *Tinca tinca* and *Leuciscus ida* introduced near Washington, D. C. have not survived (Musick, 1972). However, periodic introductions of popular aquarium fishes should be expected.

Salinity tolerance has enabled some non-indigenous species, such as *Beleonesox belizanus*, *Cichlasoma urophthalmus*, *Clarias batrachus*, *Sarotheron melanotheron* and *Tilapia mariae* to disperse broadly into estuarine areas (Courtenay *et al.*, 1991; Shafland, 1996), while restricting others, such as *Cichlasoma nigrofasciatum* that tolerates salinities only up to 8 ppt (Dial and Wainright, 1983). *Cichlasoma bimaculatum* and *Sarotherodon melanotheron* are restricted from many brackish water localities, but have invaded others (Kushlan, 1986; Loftus, 1987; Martinez-Palacios, *et al.*, 1990; Jennings, 1991).

The ability to move terrestrially has permitted some some invasives, such as *Clarias batrachus*, *Monopterus albus*, and possibly *Hypostomus plecostomus* to expand their range (Fuller *et al.*, 1999). Others occupy habitats unavailable to native fishes, such as use of hypersaline environments by *Beleonesox belizanus* (Turner and Snelson, 1984) or use of polluted or anoxic environments by goldfish and *Hoplosternum littoralis* that exclude native species (Ramnarine, 1994; Robison and Buchanan, 1988; Brauner *et al.*, 1995; Nico *et al.*, 1996). However, such refugia, do not always facilitate range expansion. *Cichlasoma bimaculatum*^a (Lee *et al.*, 1980; Shafland, 1996) and *Cichlasoma octofasciatum* (Obordo and Chapman, 1997) can

tolerate low oxygen concentrations but have not yet expanded their range to the extent early research predicted (Courtney *et al.*, 1974).

Some invasive species, such as *Cichlasoma bimaculatum*, *C. occelaris*, *C. urophthalmus*, *Sarotherodon melanotheron*, and *T. mariae*, support recreational fisheries and this has led to expansions of their non-native ranges (Courtenay and Stauffer, 1990; Fury and Morello, 1994; Shaffland, 1995, 1996), although not always (Guest *et al.*, 1979, Howells and Garrett, 1992; Jennings and Williams, 1992).

Transplantations for fisheries purposes have resulted in many species native to the region now being found in other areas within the region, but outside their native range (Fuller *et al.*, 1999). Although ecological effects of such transplantations are better than for most non-indigenous species, particularly where these stocks are depleted for recreational, subtle alteration of natural genetic variation is beginning to be recognized. Transplantation of Atlantic stocks of *Morone saxatilis* into the Gulf of Mexico has displaced original stocks in Texas, Louisiana, and Mississippi (Wirgin *et al.*, 1997), furthering difficulties faced by already declining stocks (Gibson, 1993; Pendleton, 1995). Similar loss of genetic diversity has been linked to widespread stocking of *Micropterus salmoides floridanus* across the native range of *M. s. salmoides* (Philipp, 1991).

^a As noted by Eschmeyer (1998, p. 229), use of the scientific name of this species is problematic.

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REVIEWS

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Castro, Peter and Michael B. Huber. 2000. **Marine Biology (3rd ed.)**. McGraw- Hill, New York, NY. \$49.00. 444 p.

Where, oh where has Castro and Huber's marine biology book been all this time? I like this great book for it is so easy to read and vividly flows from the beginnings of marine biology, its scientists and methods of study, through definitions to composition of the oceans, the organisms in the sea, to man's involvement and influences to this last frontier: Planet Earth.

With man's increasing interest in the marine world and its contents, this volume provides the answers for young, old, and even scientists alike. The authors make you think about the how, when, where, why, and what remains for the future. Written with a global non-regional perspective for lower division non-science majors at colleges and universities, the contents are flexible and broadly written so that students and teachers can use it, be they political science majors interested in fishery policy or engineering majors interested in ocean technology.

What makes this volume great is that, even though there are four parts, the authors lead (highlights define terms) you through the principles of marine science (Chaps. 1-3), to life in the marine environment (Chaps. 4-8), structure and function of the marine ecosystem (Chaps. 5-15), to man and resources of the sea (Chaps. 16-18). The text flows as an adventure from marine science's beginnings to various biota (from bacteria to mammals) to how they interact to man and his effects on the organisms through overfishing, pollution, and changes in global warming, etc. I was amazed how this volume's contents were so up to date. For example, you will find information on the collapse of the cod fishery, safe tuna-dolphin fish controversies, up-to-date hypotheses (lottery vs. deterministic), effects of the 1997-1998 El Niño - La Niña, effects of *Pfisteria*, plate tectonics, etc. All this is accomplished in 444 pages, a 19-page glossary, four appendices, three pages of credits, and a 10-page index.

Alas, with any so well-presented volume, there are some disappointments. For example: web site recommendations occur in each chapter, but not everyone has a computer; box on p. 57 doesn't tell you where or when the Kanazawa wave occurred; fig. 4.16 (p. 74) depicts a sea turtle but makes no mention of the papillomas affecting it; *Trapeza*

rufopunctata (p. 104) is not italicized; there are 1,000, not 500, marine fungi (p. 100); there are about 25,000 fishes, not 22,000 (p. 140); the stonefish picture (p. 146) is hardly recognizable; leatherback sea turtles attain +2,000 pound weights, not 1,200 (p. 167); no mention is made of how the heavier sea water is affected by the Coriolis effect (p. 242); the Great Barrier Reef *spans* 2,000 km, not *runs* (p. 287); no mention of how the Dutch kept the North Sea out by building mats (p. 406); fishes can be found to the very depths of the oceans (Rass, 1974); "obligate symbionts" (p. 298) is not in glossary; Robins and Ray (p. 415) is backward in the literature cited.

The most confusing aspect of the volume is the numbering system for the figures, *i.e.*, fig. 5.1 or 5.24 on pages 84 and 102 means Chapter 5 figure 1 or 24. Why not use the CORE scientific literature references to a topic rather than relying solely on American Scientist, National Geographic, Discovery, *etc.* sources? References to real published papers should have been included so one could seek out the actual data rather than from summary papers.

All is forgiven, for who can complain when the volume cover depicts the beautiful blue sea squirt (*Rhopilema crassa*) from Bali, Indonesia? Lead on, for I'm eager for more.

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Feidhamer, G. A., L. C. Drickamer, S. H. Vessey, and J. F. Merritt. 1999. **Mammalogy: Adaptation, Diversity, and Ecology**, 1st ed. \$58.25. 563 p. McGraw-Hill Press, N.Y.

Mammalogy: Adaptation, Diversity, and Ecology consists of 29 chapters and is organized into five parts: Introduction; Structure and Function; Adaptive Radiation and Diversity; Behavior, Ecology and Biogeography; and Special Topics. After extensive coverage of a single topic, each chapter concludes with a summary section, list of discussion questions, and a list of suggested readings pertaining to the topics of the chapter. At the end of the book there is a glossary of terms, complete list of references, and a subject and scientific name index. Discussion questions generally are difficult and many provide information useful for the formation of essay questions. The reference list is thorough and is an excellent resource for readers interested in further exploring topics discussed in the text.

The Introduction covers the study and history of mammalogy including descriptions of early naturalists and resources for mammalogists. Methods and techniques for studying mammals are also discussed in this section. Field methods such as trapping, marking, and radiotracking are covered. Laboratory techniques such as the use of morphometrics and DNA assays in determining levels of relatedness also are described. Recent developments in applications of global positioning and geographic information systems for modern mammalogists are discussed. This section ends with a discussion of the evolution of mammals and a description of dental characteristics. It also provides a good overview for the remainder of the text. The section covering techniques for studying mammals is excellent in that it discusses modern advances (e.g. some molecular techniques) discovered since the writing of the excellent text, *Mammalogy*. (Vaughan, 1986). The chapter covering the evolution of mammals provides adequate coverage without overwhelming the reader.

Structure and Function covers the integument, structure and movement; foods and feeding; the nervous and endocrine systems, and biological rhythms; environmental adaptations; and reproduction. This section provides a thorough description of mammalian

anatomy and physiology and includes a discussion of the role of natural selection in the development of these systems and the biological rhythms they produce.

Adaptive Radiation and Diversity covers the 26 mammalian orders. Both terrestrial and marine mammalian orders are thoroughly described. Each order is covered in a chapter that discusses the morphology, fossil history, economics, and conservation of its members. A general description of the natural history of the suborders and families is given. Many photographs and illustrations of skulls and other morphological characteristics that are helpful in describing the general morphological characteristics that typify each order are included in each chapter. We found the listing of all higher taxonomy (*i.e.* orders, suborders, and families) of the class Mammalia (following the taxonomy of Wilson and Reeder, 1993) to be an extremely useful reference. This section does a good job describing the mammalian orders in an interesting and enjoyable manner. There is enough information to provide an adequate overview of the orders without overwhelming the reader with natural history facts. Although there are numerous reasons to place this section after the section on structure and function, we feel the order of the book would have been improved by discussing the general characteristics of each order prior to discussing mammalian structure and function. It may be more beneficial for the reader to have a more thorough introduction to the mammalian orders before delving into descriptions of the evolution of variations in structure and function.

Behavior, Ecology, and Biogeography discusses how mammals interact with each other and their environment. Topics such as communication, aggression and spatial relations; sexual selection, parental care, and mating systems; social behavior; dispersal, habitat selection, and migration; populations and life history; community ecology; and zoogeography are covered. It synthesizes the knowledge readers have gleaned from previous chapters about the natural history, anatomy, and physiology of mammals and describes how these characteristics influence how mammals interact with one another and their environment.

Special Topics covers a range of topics that, with the exception of conservation, are too rarely discussed in "current" courses in mammalogy. Many issues discussed in the final section, such as zoonoses, are topics that are becoming more important to mammalogists daily. Other topics include parasites; domesticated mammals; and conservation. This section describes both the positive, such as conservation, and negative, such as habitat destruction, impacts humans have had on mammals.

Despite the fact that minor editorial mistakes such as typing errors and mislabeled figures abound, we found this book to be an excellent mammalogy text. Its usefulness and thoroughness makes this text comparable to *Mammalogy* by Vaughn (1986). It is an attractive book filled with wonderfully descriptive illustrations. It is current and easy to read. Although *Mammalogy* remains an excellent text, there is little doubt that the currentness of this text, especially with respect to taxonomy, will tempt many mammalogy instructors to use this text in the future.

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Miller, S. A. and J. B. Harley. 1999. **Zoology**. Fourth ed. WCB/McGraw-Hill, Boston. \$50.00. 750 pp.

Many of us became biologists as a result of our first course in biology, often because the professor was stimulating. I entered college as a pre-med major, but by the end of my freshman year and two semesters of General Zoology I was so fascinated by animals that I had forgotten medicine and intended to become a biologist. This textbook is the kind that could help inspire students to pursue biology — especially if the instructor is also interesting. This is an up-to-date, well written, and colorful textbook. It includes most of the things I expect from a good zoology text: discussion of evolutionary concepts, mechanisms and processes, phyla, and relations between animal groups.

The authors, Stephen A. Miller of College of the Ozarks and John B. Harley of Eastern Kentucky University, say in the preface that their goals were to produce an up-to-date edition that was comprehensive yet manageable in size, adaptable to the approach of the instructor, and clear, accurate, and readable. They have done these things, producing a textbook that is shorter (<700 pages of text) and lighter in weight (1.7 kg) than many, and that is very readable — clear and interesting with numerous well-designed figures.

The book would work well as the text for an introductory two-semester General Zoology course. With 39 chapters this would mean covering at least one chapter a week to get through the whole book. The book could also be used for an advanced, one-semester course in animal biology, especially if the instructor concentrated on the 16 chapters dealing with phyletic groups. However, the text is not as detailed as some upper level texts on biology of invertebrates and vertebrates.

The book is organized into six parts. Part 1, "Science, the Cell, and Molecular Biology," includes introductory concepts with chapters on the nature of science, molecules, cells and tissues, and metabolism and energy. Part 2, "The Continuity of Animal Life," covers generative processes — cell division, genetics, chromosomes, DNA, and embryology. Part 3, "Evolution," consists of two chapters on historical aspects of evolution and evolutionary theories and on gene frequencies; this is the shortest of the five sections with 26 pages. Part 4, "Behavior and Ecology," has chapters on behavior and on ecology at various levels from individuals and populations to communities and ecosystems. Part 5, "Animal-like Protists and Animalia," is the longest section (300 pages) and covers protozoans and major and minor animal phyla. The final section, Part 6, is entitled "Form and Function: a Comparative Perspective." This is a relatively long section (170 pages) and consists of chapters on organ systems and processes (musculoskeletal and integumentary; sensory; endocrine; circulatory and immune systems and respiration; nutrition and digestion; regulation of temperature and body fluids; reproduction and development).

The chapters contain a number of helpful aids for students. Each begins with an outline of chapter contents, concepts to be covered, and a box headed "Would you like to know - - -" which asks questions based on main concepts (such as, on p. 241, "Would you like to know whether all protozoan phyla track to a single Archaean ancestor?"). At the end of chapters are not only such usual items as a summary, selected key terms (ca. 10 per chapter), questions to stimulate critical thinking, and suggested readings (books and articles—many from *American Scientist* and *Scientific American*), but also references to sites on the World Wide Web. Unfortunately, not all sites were accessible. I checked the sites from four chapters and could only access 62% of them (28 of 45).

The book is colorful. The cover has an attractive photograph of an orange nudibranch grazing on green plants. Within each chapter, the text is supplemented with numerous color figures (average of 19 per chapter). These included good photographs of animals,

drawings of structures, diagrams, and light and electron photomicrographs (such as a nice SEM series on a spermatozoon entering an egg). The chapters also include boxed readings on topics tangential to the chapter (such as readings on transgenic animals in the molecular genetics chapter and on genetic equilibrium in the chapter on gene frequencies). Scattered throughout each chapter are boxes headed "Stop and Ask Yourself" with questions pertaining to the text (as, on p. 311, "What is the function of the nematode cuticle?"). New to this edition are "Wildlife Alerts," boxes placed throughout the book which introduce students to endangered and threatened species and highlight eleven of them in detail. I was concerned that the numerous figures and boxes would disrupt reading of the text; however, today's students have been conditioned by television and web pages to accept numerous disruptions and flashes of images, so doubtless they would not be bothered by them here.

The publisher (formerly known as William C. Brown) makes available an array of supplementary material, from the usual test guide, lab manual, and student study guide to CD-ROMs and collected readings. They also have a book, *How to Study Science*, to help students learn important skills such as taking notes, preparing for tests, and managing time. The publisher also will prepare customized lab manuals — lab manuals containing only the chapters to be used in a specific course. I have used these in conjunction with another WCB text, and they do help keep down costs to students.

To judge whether this is an adequate text for a course in zoology I compared it with two other books on my shelf, Dorit *et al.* (1991) and an old edition of an old classic, Storer *et al.* (1979). The Miller and Harley text stacked up well against the other two in most aspects; it had fewer pages than either, was only two-thirds the weight of Dorit *et al.*, and it covered the same topics. The writing in the Miller and Harley text is as clear or clearer than in the other two. However, there were two areas in which I felt it did not compare well. One is that it Miller and Harley do not have as great an emphasis on evolution as do Dorit and coauthors. I prefer the approach in the Dorit text, in which the comparative approach is emphasized, evolution is described as the core of modern biology, and evolutionary concepts are integrated in all parts of the text. Miller and Harley discuss evolution and present modern concepts, but they do not emphasize evolution as much and do not integrate it into all parts of the text. Since many U.S. college students are ignorant of evolution and its implications, I feel we should make an effort to include evolutionary concepts wherever appropriate. I would like to see more emphasis on evolution and better integration of it into the whole text than Miller and Harley provide.

Another aspect of Miller and Harley's text that bothered me was their emphasis on human biology. Whereas Storer *et al.* and Dorit *et al.* have confined most of their discussions of human biology to separate chapters, Miller and Harley include human biology in each chapter on the systems. This was particularly obvious in the chapter on reproduction, which included five pages on general and invertebrate reproduction and 12 pages on human reproduction. A few of the figures were not even labeled as human, such as Fig. 39.12, "Major Events in the Female Ovarian and Menstrual Cycles," and Fig. 39.16, "Stages of Labor and Parturition." Naturally students are most interested in the species to which they belong, but this approach can lead them to think our species is representative of all animals, when it is only one of more than 4000 species of mammals, a class in just one of the phyla of the animal world. A course in zoology should give students perspective on our species, not encourage them to think it is the only species that matters.

I found few other things to quibble about in this text. I did not spot any typographical errors (except in one website name). However a figure of the light microscope did show the light source as merely a mirror instead of a built-in lamp, which indicates a rather old figure

was used. Many of the figures are ones I know from other textbooks. Included, of course, are classic photographs that we are familiar with -- Konrad Lorenz being followed by his imprinted geese, a red blood cell bound up with fibers of fibrin, and peppered moths affected by industrial melanism. However, I was bothered by seeing a number of the same diagrams and figures that are printed in other introductory texts by the same publisher. I was familiar with six of 16 figures in the chapter on reproduction. Presumably students will be less aware of this than I was.

In general, I recommend this text, especially for an introductory zoology course. Despite the reservations I have, I would use it. It is attractive and well written and covers the material well.

References Cited:

- Dorit, R. L., W. F. Walker, Jr., and R. D. Barnes. 1991. *Zoology*. Saunders College Publishing, Philadelphia. 1009 + 63 pp.
- Storer, T. I., R. L. Usinger, R. C. Stebbins, and J. W. Nybakken. 1979. *General Zoology*. Sixth ed. McGraw-Hill Book Company. 902 pp.

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AIBS RELEASES STATEMENT IN RESPONSE TO KANSAS BOARD OF EDUCATION DECISION ON EVOLUTION

Washington, DC, 30 August 1999---To reflect its concern regarding the recent decision by the State of Kansas Board of Education to remove evolution from the state's science curriculum, the AIBS Board of Directors has issued the following statement:

The State of Kansas Board of Education has decided not to require the teaching of evolution in the state-approved science curriculum. This unfortunate decision means that many students will no longer be exposed to some of the most exciting and important advances in modern biology. The Board's decision will send many into adulthood burdened with a profound lack of knowledge about a subject that underlies all of biology and that links the life sciences with equally fundamental components of chemistry, physics, and geology.

All scientific explanations are provisional and subject to revision in the face of new data and theories. Biologists today are engaged in vigorous debates about the mechanisms by which evolution occurs and the historical pattern and sequence of events through which life's diversity has arisen over billions of years of history, but they spend no more time debating whether evolution occurred than physicists do debating whether quantum mechanics correctly predicts the behavior of individual electrons. Because biologists accept and use evolutionary explanations in their work, the Kansas Board of Education's decision serves only to prevent its students from acquiring a comprehensive understanding of modern biology.

The American Institute of Biological Sciences urges boards of education and local school boards in every state to ensure that their students receive an education in all major tenets of modern science, including evolutionary biology.

AIBS is planning to hold an interactive roundtable on the topic of evolution in Washington, DC, in the near future. Participation will be available on-site and via teleconference. Details will be available and distributed this fall; contact the AIBS Communications Office at 202/628-1500, ext. 253, or jkolber@aibs.org for more information.

ANNOUNCEMENTS

At the Millennium, a Look Back and a Look Ahead

From 22 to 24 March next year, some of the country's most preeminent scientists will gather in Washington to review major advances in organismal and integrative biology made during the last century, and look ahead to future goals and challenges. The meeting is being cosponsored by the American Institute of Biological Sciences (of which The Association of Southeastern Biologists is a member organization) and the Smithsonian Institution. "Biology: Challenges for the New Millennium," which is also the 51st annual meeting of AIBS, will be held at the Smithsonian in Washington, DC.

This unique millennial event includes speakers Stephen J. Gould, Daniel H. Janzen, Gene E. Likens, Lynn Margulis, Gordon Orians, Ghilleen Prance, Marvalee Wake, and Edward O. Wilson, and also offers attendees the chance to meet these notable scientists. Interactive breakout sessions will follow each plenary to discuss recent advances and future challenges in the fields of Behavior, Biodiversity & Conservation, Development & Morphology, Ecosystems, Energetics, Environment, Evolution, Integration, Regulation, and Science & Society. The Association of Southeastern Biologists has been invited to participate in the event by leading a breakout session.

Other meeting features include a lecture by special guest Ernst Mayr, a workshop on the teaching of evolution (co-sponsored with the National Association of Biology Teachers), and a showing of the Smithsonian's new 3-D IMAX film on the Galapagos Islands. A limited number of poster submissions are also being accepted.

Register online now and/or submit a poster abstract at www.aibs.org/meeting/2000/. For more information contact AIBS Meetings Manager Marilyn Maury at 703/834-0812, ext. 203, or mmaury@aibs.org.

Gibbs Award for Excellence in Systematic Ichthyology

Nominations are invited for the American Society of Ichthyologists and Herpetologists (ASIH) Robert H. Gibbs, Jr. Memorial Award for Excellence in Systematic Ichthyology.

The prize is awarded for an outstanding body of published work in systematic ichthyology by a citizen of a Western Hemisphere nation who has not been a recipient of the award. The award is offered annually and consists of an appropriate plaque and a cash award (for 2000 this will be \$7,500). The award recipient is announced at the annual meeting of the ASIH. The Award for 1999 was presented to Dr. William N. Eschmeyer, Senior Curator, Department of Ichthyology, California Academy of Sciences, San Francisco, for his three volume work "Catalog of Fishes" and his many contributions to the systematics of fishes, especially the scorpaeniforms.

Nominations may be made by any ichthyologist, including self nominations, and should include the nominee's *curriculum vitae*, and detail the nominees's specific contributions and their impact on systematic ichthyology. Nominations must be received by March 1 of the year to be eligible for the award for that year. Nominations will be effective for three award periods. Four copies of each nomination should be sent to Dr. Robert K. Johnson, Grice Marine Biological Laboratory, 205 Fort Johnson Road, Charleston, SC 29412, USA.

POSITIONS AVAILABLE

Herbarium Curator/plant Taxonomist Department of Botany, North Carolina State University

The Department of Botany at North Carolina State University is seeking a herbarium curator/plant taxonomist. Major duties are to manage and improve the NC State University herbarium, identify plant specimens submitted by county extension agents and other clientele, take responsibility for outreach activities of the herbarium, and provide support for documenting research collections and for teaching activities requiring the herbarium. Applicants should have an M.S. degree in Botany or related field with an emphasis in plant systematics, and previous experience in plant identification and herbarium management. Applicants must have strong oral and written communication skills, computer skills, and a commitment to extension outreach. Send a curriculum vitae, statement of career goals, and the names of three references to: Dr. Margaret Daub, Interim Head, Department of Botany, Box 7612, North Carolina State University, Raleigh, NC, 27695-7612. Phone: (919) 515-2727, FAX: (919) 515-3436, E-mail: margaret_daub@ncsu.edu. Application Deadline: December 30, 1999, or until a suitable candidate is located. North Carolina State University is an Equal Opportunity Employer and operates under Affirmative Action Policy. Individuals with disabilities desiring accommodations in the application process should contact Margaret E. Daub at the above address, email, fax or phone numbers.

Mississippi State University

Three tenure-track faculty positions as Assistant Professor of Biological Sciences; nine-month, teaching and research appointments. All three successful applicants will be expected to develop an externally funded research program and to direct M.S. and Ph.D. graduate students. The successful candidate will be committed to excellence in undergraduate and graduate teaching. Date available: August 16, 2000. Interested persons should submit a curriculum vitae, a concise statement of research and teaching interests, selected reprints and should arrange to have three letters of reference sent to the respective contact persons.

POSITION 1: Microbial Geneticist. Applicants must have a completed Ph.D. in a relevant field and an established record of research productivity. Teaching and postdoctoral experience are desirable. Area of research expertise is open. Contact Dr. Donald N. Downer, Head Microbial Geneticist Position, Department of Biological Sciences, P. O. Box GY, Mississippi State, MS 39762

POSITION 2: Plant Ecologist. Applicants must have a completed Ph.D. in a relevant field and an established record of research productivity. Teaching and postdoctoral

experience are desirable. We are seeking a broadly trained individual who uses quantitative approaches to study the ecology of plants. Preference will be given to applicants working at the community or landscape level. Contact Dr. Christopher M. Taylor, Chair, Plant Ecologist Position, Department of Biological Sciences, P. O. Box GY, Mississippi State, MS 39762

POSITION 3: Molecular Evolution. We are seeking a broadly trained individual who uses molecular techniques to study evolutionary mechanisms. Preference will be given to applicants studying evolutionary developmental biology. Qualifications include a completed Ph.D., an established record of research productivity, and postdoctoral experience. Teaching experience is desirable. Contact Dr. Michael J. Sullivan, Chair, Molecular Evolutionist Position, Department of Biological Sciences, P. O. Box GY, Mississippi State, MS 39762, Phone: (662)325-7575, email: sullivan@biology.msstate.edu.

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Appalachian State University
Department of Biology
www.biology.appstate.edu

Appalachian State University, with an enrollment of 12,500, is one of the top comprehensive universities in the southeast. The Biology Department has 21 faculty, 500 majors, and 30 graduate students and is committed to an extensive laboratory and field experience for our majors. The Department is currently conducting searches for two tenure-track faculty positions and a Molecular/Microbiology/Cell Biology Laboratory Technician:

Freshman Biology Program Director: Primary responsibilities will be to design and implement an effective laboratory-based freshman biology curriculum for majors and nonmajors. The Director will be expected to participate in teaching lectures and labs in the program, develop a program of scholarship in biology involving undergraduate and graduate research, and seek extramural funding. Areas of scholarly interest may include but are not limited to: innovations in teaching methods, curriculum reform, or a subdiscipline of biology. The successful candidate must have a Ph.D. in the biological sciences and a record of accomplishment or training in biology educational program development; a demonstrated expertise in multimedia use is desirable.

Science Education: Primary responsibilities will include teaching lecture and laboratories in science content pedagogy for K-12 pre-service teachers, managing science education laboratory facilities, developing computer technology applications for science methods courses and supervising biology student teachers. Other expectations include: developing a research program in science education or a subdiscipline of biology, seeking extramural funding, participating in undergraduate and graduate education, and developing a close working relationship with the Appalachian Math and Science Education Center in its K-12 outreach programs. The successful candidate must have a doctorate, with graduate degrees in both life science and science education as well as public school teaching experience.

Submit a letter of application, curriculum vitae, description of teaching and research interests, statement of teaching philosophy, and names, addresses and phone numbers of three references by January 15, 2000 to: Dr. Vicki J. Martin, Chair, Department of Biology, P. O. Box 32027, Appalachian State University, Boone, NC 28608-2027. E-mail: martinvj@appstate.edu

Molecular/Microbiology/Cell Biology Laboratory Technician: The Department of Biology at Appalachian State University invites applications for a Molecular, Microbiology, Cell Biology Laboratory Technician. Primary responsibilities will include: preparation of materials for teaching laboratories primarily in molecular and microbiology, but also in cell biology and immunology, maintenance of cell lines, trouble shooting of lab protocols, overseeing of common-use equipment, training of new users, ordering of lab supplies, and organization and maintenance of lab facilities. Additional duties include: scheduling user time on high demand pieces of equipment, keeping records of equipment maintenance and maintenance schedules, overseeing student use of equipment outside of regular scheduled labs, and possible laboratory teaching. The candidate will be expected to have a working knowledge of molecular techniques, cell culturing techniques, and computer skills. Additionally, the individual must have good organizational skills, the ability to work with a variety of people, and the desire to learn new techniques. The successful candidate must have a masters degree in biology with research experience in molecular biology. Submit a letter of application, curriculum vitae, copies of transcripts, and three letters of reference by February 15, 2000 to Dr. Mary U. Connell, Department of Biology, P. O. Box 32027, Appalachian State University, Boone, NC 28608-2027. Appalachian State University is an Equal Opportunity Employer.

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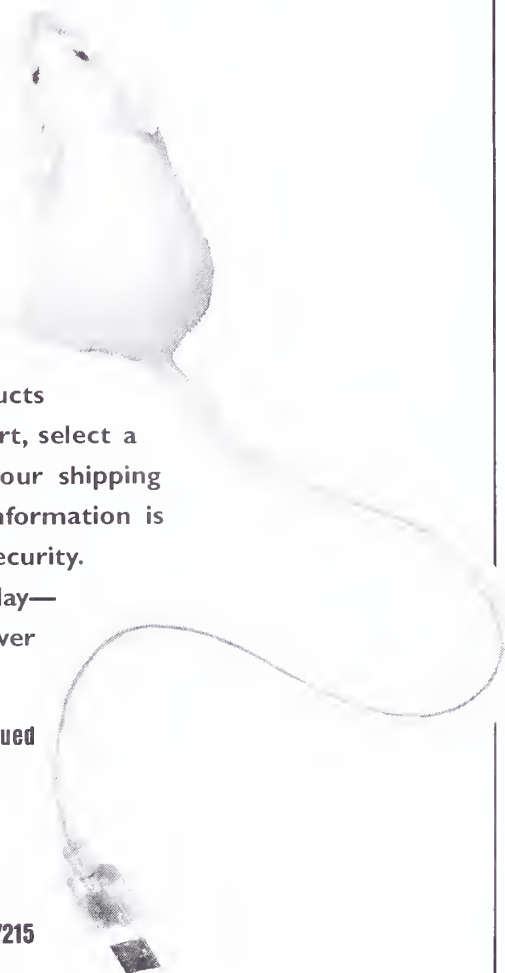
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In This Issue

Coastal Ecology Symposium Proceedings	245
The Importance of Coastal Wetlands: Why Do We Need to Protect Them? William Kruczynski	246
Changes in Seagrass Distribution and Diversity: Is this a Good Thing? Michael J. Durako ..	273
Coastal Phytoplankton Blooms: What Are They Telling Us? Gabriel A. Vargo	286
Biological Impact of the Gulf Stream on Coastal Marine Ecosystem Robert Y. George and David Lindquist	310
Coastal Fish Distribution and Diversity in the Southeastern United States: How Is it Changing? Stuart G. Poss	320
Reviews	330
AIBS Statement on Kansas Decision on Evolution	335
Announcement	336
Positions Available	337

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